AUG 6 1923

Printed on Thin Paper for Foreign Circulation.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXVI.—No. 3525] LONDON: FRIDAY EVENING, JULY 20, 1923 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Electric Drive for a 34in. Rolling Mill (With a Two-Page Drawing).

Reconditioning St. James's Park Lake.

The Navigation Congress.

A Thames-side Motor Car Works.

The Swedish Navy.

Gas-Driven Alternators for South Africa (No. II).

Railways in Bolivia.

Institution of Civil Engineers: Conversazione Exhibits.

PUBLIC NOTICES

FUEL ECONOMISERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 8th August, 1923, for the SUPPLY and ERECTION of FUEL ECONOMISERS at the P.O. Telegraph Factory, Birmingham.

Drawings, specifications, and forms of Tender may be obtained from the CONTRACTS BRANCH, H.M. OFFICE OF WORKS, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Secretary, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 3084

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES:

CARRIAGE UNDERFRAMES.

Tenders due on the 10th August, 1923.
Tender forms obtainable from above. 3065

By Order of the Secretary of State for India in Council.

REQUIRED for service on INDIAN STATE RAILWAYS (North-Western Railway), ONE STRUCTURAL ASSISTANT BRIDGE ENGINEER, who will be required to work in the Technical Bridge Office or on reconstruction of bridges in the field.

Candidates must have had a good general and technical education and have had practical experience in structural engineering and in the design and preparation of estimates in detail for large girders, also in the computation and analysis of stresses in structures.

Age not less than 25 nor more than 28 years; bachelor preferred.

Salary Rs. 525 per mensem, rising by annual increments according to the scale in force for approved service.

Engagement in the first instance for 3 years.

The selected candidate will be required to pass the Medical Board, India Office, before appointment.

Application may be made by letter only, and candidates must give full particulars of their general and technical education, their practical training and designing and estimating experience, in chronological order, with dates. Age should be stated and details of war service (if any). Letters of application, with copies only of testimonials, which cannot be returned, should be sent to the undersigned not later than 4th August, 1923.

RENDEL, PALMER and TRITTON,
12-14, Dartmouth-street,
Westminster, London, S.W. 1.
12th July, 1923. 3088

Assistant Engineers Required for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, with prospect of permanency. Salary 400 dollars a month, rising to 800 dollars a month by annual increments of 25 dollars a month plus a temporary non-pensionable allowance of 10 per cent. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but the purchasing power in Malaya is at present considerably less than that of 2s. 4d. in the United Kingdom. Free passage provided. Candidates, age 25 to 35, unmarried, must have received a good theoretical training, preferably at a University or Engineering College recognised by the Institution of Civil Engineers, or have completed articles with civil engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. Possession of an Engineering or Science Degree preferred. Must have had at least two years' practical experience in the design and execution of works of some considerable magnitude. A knowledge of modern roadmaking and maintenance is desirable.—Apply at once, by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/12,156/7. 3098

Works Manager Required for the IRAQ (formerly Mesopotamia) RAILWAYS, for two years, with possible extension. Salary Rupees 950 a month, with an increment of Rupees 50 for the second year of approved service. Free quarters and passages. Candidates, age 35 to 45, should have received a liberal education and have specialised in the study of mechanical engineering and have obtained a satisfactory degree or pass in their studies. They must have had not less than five years' experience in a railway workshop and have had practical experience in the erection and maintenance of locomotives, carriages and wagons. They must possess a sound knowledge of machines generally used in locomotive and carriage and wagon works. They should have a good knowledge of workshop accounts and be able to frame estimates of cost.—Apply at once, by letter, stating age and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/11,984. 3066

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. TENDERS for the SUPPLY of:—

(1) DUPLICATE PARTS for LOCOMOTIVES;
(2) DUPLICATE PARTS and FITTINGS for CARRIAGES and WAGONS;
(3) LAMINATED SPRINGS;
(4) LOCOMOTIVE AXLES;
(5) METALS: Antimony (White), Brass, Copper, Lead, Zinc, and Phosphor-bronze;
(6) BOGIE CARRIAGES;

for Nos. 1, 2, 3, 4, and 5 on Wednesday, the 1st August proximo, and for No. 6 on Wednesday, the 15th August proximo.

Copies of the specifications can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE, Secretary.
73-76, King William-street, London, E.C. 4.
19th July, 1923. 3119

Kirkstead Drainage District, LINCOLNSHIRE.

The Board of the above Drainage District invite TENDERS for the PROVISION of a PUMPING PLANT for an area of about 1200 acres. Plans and specifications can be seen at the office of Mr. G. E. C. Harding, C.E., 29, Broadgate, Lincoln.

Tenders, marked "Plant," must be delivered to me, the undersigned, not later than the 30th instant.

The Board do not bind themselves to accept the lowest or any Tender.

By Order,
R. CHATTERTON,
Clerk to the Board.
5, Church-lane, Horncastle,
18th July, 1923. 3104

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for (1) VOLUTE SPRINGS, (2) BUFFER PLUNGERS AND CASES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 19th July, 1923.

A fee of £1 1s. will be charged for each specification, which is not returnable.

Tenders must be submitted not later than Noon on Thursday, 2nd August, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
R. C. VOLKERS,
3092 Secretary.

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for: 815 CAST STEEL AXLE-BOXES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 19th July, 1923.

A fee of £1 1s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Tuesday, 31st July, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order Of the Board,
R. C. VOLKERS,
3064 Secretary.

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for: 1050 STEEL TYRES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 18th July, 1923.

A fee of £1 1s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Wednesday, 1st August, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. C. VOLKERS,
3077 Secretary.

Borough of Stockton-on-Tees.
ELECTRICITY DEPARTMENT.

TENDERS are INVITED for the PURCHASE in situ of the following PLANT:—

5 LANCASHIRE BOILERS with MECHANICAL STOKERS.
2 TRIPLE-EXPANSION D.C. 500-VOLT GENERATING SETS, 300 and 400 K.W.
ONE 500 K.W. D.C. 500-VOLT TURBO-GENERATOR, with CONDENSER and PIPES, STEAM and EXHAUST PIPES, FEED PUMPS, &c. &c.

Further particulars and form of Tender may be obtained from Mr. S. G. Marston, Corporation Electricity Works, Thompson-street, Stockton-on-Tees.

The plant may be seen by appointment.

Purchasers will be expected to dismantle and remove plant at their own expense.

Tenders, endorsed "Tenders for Electricity Plant," must be sent to the undersigned on or before the 4th day of August next.

No undertaking is given that the highest or any other Tender will necessarily be accepted.

Dated this 17th day of July, 1923.

THOS. DOWNEY,
Town Clerk.
Borough Hall, Stockton-on-Tees. 3073

PUBLIC NOTICES

Irish Free State.
HAULBOWLINE DOCKYARD.

The Government of the Irish Free State are prepared to consider OFFERS for the LEASE of the above NAVAL DOCKYARD situated at the entrance to Cork Harbour and containing extensive wharf and warehouse accommodation with large dry dock and slipways. The yard is provided with 60-ton shear legs, travelling cranes, and well-equipped machine shops.

Specifications, drawings and particulars may be obtained from

J. F. CROWLEY and PARTNERS,
Consulting Engineers,
16, Victoria-street, Westminster.

Offers, which should indicate the employment that would be afforded, should reach the above not later than August 25th.

The Government do not bind themselves to accept the highest or any Offer. 3071

Salford Board of Guardians.
UNION INFIRMARY, STOTT-LANE, PENDLETON, NEAR MANCHESTER.

The Guardians invite TENDERS for NEW LANCASHIRE BOILER, ECONOMISER, FEED PUMPS, STEAM and WATER PIPES, &c., in connection with the Laundry and Extensions to the Heating and Hot Water System at the Union Infirmary.

Drawing of the plant and detailed specification of the new boiler may be inspected at the offices of the Engineer, Mr. T. Roland Wollaston, M.I. Mech. E., Lord's Chambers, 26, Corporation-street, Manchester. Form of Tender, general specification and conditions of contract may be obtained from me on receipt of cheque for Two Guineas, which will be refunded upon receipt of bona fide Tender.

The Guardians do not bind themselves to accept the lowest or any Tender, and the selected contractor will be required to subscribe to the conditions as regards employment of labour, &c., as set forth in their regulations.

Sealed Tenders, endorsed "Engineering, Section 1," must be delivered at my offices not later than 10 a.m. on Saturday, August 4th, 1923.

By Order,
E. H. INCHLEY,
Clerk to the Guardians.

Poor Law Offices,
Eccles New-road, Salford,
17th July, 1923. 3078

State Electricity Commission OF VICTORIA.
TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to:—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 23/117.—22,000-VOLT INSULATORS.

CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract, specification complete. These charges will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £20 is to be lodged with the Tender.

The specification may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon on 6th October, 1923.

E. LIDDELOW,
Secretary,
State Electricity Commission of Victoria,
Melbourne, Victoria,
3074 Australia.

PUBLIC NOTICES

UNIVERSITY OF LONDON.
King's College.

FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY, extending over either three or four years, are arranged in CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

The four years' Course provides, in addition to the academic training, opportunity for practical training in "Works."

HEADS OF DEPARTMENTS.

Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering.
C. A. GENEVE, B.Sc., A.M.I. Mech. E., Senior Lecturer.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
C. H. LOBBAN, B.Sc., A.M. Inst. C.E., Senior Lecturer.
Professor E. WILSON, M. Inst. C.E., M.I.E.E. (Dean), Electrical Engineering.
R. E. SHAWCROSS, A.M. Inst. C.E., M.I.E.E., Lecturer.
Professor S. A. F. WHITE, M.A.; Professor G. B. JEFFERY, M.A., D.Sc., Mathematics.

Considerable extensions have been made in the Engineering Department. These include a large additional Drawing-office, Lecture Room, and Laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments; and Research Rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 3052

University College of Swansea
(A Constituent College of the University of Wales).

APPLIED SCIENCE DEPARTMENTS.

ENGINEERING.

Professor: FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: H. H. BURNESS, M.C., B.Sc. (St. Andrews), A.M. Inst. C.E., A.M.I. Mech. E.
Assistant Lecturer: J. SELWYN CASWELL.

METALLURGY.

Professor: C. A. EDWARDS, D.Sc. (Manchester).
Lecturer: H. I. COE, M.Sc. (Wales and Birmingham).
Assistant Lecturers: A. L. NORBURY, M.Sc. (Manchester); L. B. PFEIL, B.Sc. (Lond.), A.R.S.M.

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the staff and students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials co-operate with the staff at the College in making visits to works of practical educational value to the students.

Courses of study are provided: (1) for the B.Sc. Degree of the University of Wales in (a) Civil Engineering; (b) Mechanical Engineering; (c) Electrical Engineering; (d) Metallurgy; and (2) for Diplomas of the College in (a) Civil Engineering; (b) Mechanical Engineering; (c) Electrical Engineering; (d) Metallurgy.

Persons who are not desirous of studying for Degrees or Diploma may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such Classes.

Entrance Scholarships will be offered for competition in September, 1923.

Particulars concerning admission to the College and of the Entrance Scholarships may be obtained from the undersigned.

EDWIN DREW,
Registrar.
University College,
Singleton Park, Swansea. 3053

The Ministry of Public Works,

Egypt, is calling for TENDERS for the SUPPLY of a 12in. HYDRAULIC DREDGER and TUG for the Ibrahima Canal. Copies of specification and Tender form can be obtained from

THE INSPECTING ENGINEER,
Egyptian and Sudan Governments,
Queen Anne's Chambers,
Westminster, S.W. 1. 3096

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PARTNERSHIPS, Page 2.
PATENTS, Page 2.
MACHINERY, &c., WANTED, Page 3.
FOR SALE, Pages 3, 4 and 100.
AUCTIONS, Pages 3 and 100.
PREMISES TO LET OR WANTED Page 3.
WORK WANTED, Page 4.
AGENCIES, Page 2.
MISCELLANEOUS, Page 2.

For Advertisement Rates see Page 73, Col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS, Page 99.

PUBLIC NOTICES

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

No.		Fee for Specification.
1.	CANVASES, &c.	10s.
2.	STEEL SCREW COUPLINGS, &c.	£1
3.	STEEL DRAW-BARS for WAGONS	£1
4.	ROLLED STEEL DISC or SPOKE WHEELS and AXLES, and AXLES (FORGINGS) for CARRIAGES and WAGONS	£1
5.	SPARE PARTS of LOCOMOTIVE ENGINES	10s.
6.	AXLE-BOXES for CARRIAGES and WAGONS	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Canvases," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 31st July, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Cosphall-avenue, E.C. 2,
London, 18th July, 1923. 3115

Tyne Improvement Commission.

TENDERS FOR WASTE HEAT BOILER.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the SUPPLY and ERECTION of a WASTE HEAT BOILER for their Repairing Yard, Howdon-on-Tyne.

Copies of the form of Tender, conditions of contract and specification may be obtained on application to the undersigned on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on the cover "Tender for Waste Heat Boiler," must be addressed to the undersigned and delivered not later than Noon on Thursday, 2nd August, 1923.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
RICHARD AUGHTON,
General Manager.

Tyne Improvement Commission Offices,
Bewick-street, Newcastle-upon-Tyne,
17th July, 1923. 3087

SITUATIONS OPEN

WANTED by a Firm of Engineers Who are About to manufacture in quantities a pneumatic appliance, sample machines having already been made and tested, a THOROUGHLY EFFICIENT METALLURGIST-ENGINEER or FIRM of ENGINEERS to advise regarding the possibilities of reduction of weight of the appliance to the lowest possible limit and the lightest possible materials which can be used in the construction of the machine. Applicants must possess intimate knowledge of various steels and be able to calculate exactly working strains and stresses and undertake material tests.—Address, 3117, The Engineer Office. 3117 A

WANTED for Large Firm of Railway Rolling Stock Manufacturers, GENTLEMAN as REPRESENTATIVE for Birmingham and the Midlands. This is an excellent opening for a good man, who would be paid by salary and commission on orders obtained.—Address in the first instance, stating age, experience, and salary required, 3027, The Engineer Office. 3027 A

WANTED for South Wales District, REPRESENTATIVE, well connected with collieries, to Sell Steel Castings.—Address, giving age, experience, and connection, 3111, The Engineer Office. 3111 A

WANTED, PLANNING SUPERVISOR, First-class engineer, expert in jig and tool design for motor vehicles, the making of lay-outs and programmes for machines, familiar with efficiency methods in connection with all modern machine tools and accustomed to estimating in all its forms.

State full experience (and enclose photo), age, wage expected, &c.
Address, 3093, The Engineer Office. 3093 A

ASST. WORKS ENGINEER and DRAUGHTSMAN, for Shropshire, age 23-25. Accustomed to design, detail, and getting out specifications, quantities, and estimates for Steel, Timber and Concrete Structures, Machine, Ropeways Conveyors, and Elevators.—Apply by letter, stating experience, age, and salary required, P7721, The Engineer Office. P7721 A

CHIEF DESIGNER, with Experience in Light and Heavy Structural Steel Work. Only first-class man need apply. State age, experience, and salary required.—HEENAN and FROUDE, Ltd., Newton Heath Ironworks. 3063 A

CHIEF ESTIMATOR and RATE FIXER REQUIRED for large Engineering Works working on straight piecework system. Only those who have thoroughly up-to-date knowledge of manufacturing methods need apply.—Apply in own handwriting, giving age, salary expected, and at least two references, 3038, The Engineer Office. 3038 A

COLLIERY ENGINEER REQUIRED for Modern developing colliaries; energetic, good disciplinarian, accustomed to costings, checking consumption, materials and stores; good opening for keen, resourceful man. State age, experience, salary required, and enclose copies of recent references.—Address, 3103, The Engineer Office. 3103 A

EXPERIENCED MECHANICAL and CIVIL ENGINEERS REQUIRED in connection with a Waterworks Contract for Esthonia. Must have good knowledge of Russian and/or German.—Address, stating age, qualifications, experience, and conditions of engagement, 3056, The Engineer Office. 3056 A

INSPECTION (MECHANICAL PROCESS).—An OPPORTUNITY OCCURS in a London Engineering Establishment for a MAN about 30 years of age with a varied experience of Repetition Production. Must be progressive and possess initiative.—Address, stating age, previous experience and wages required, 3090, The Engineer Office. 3090 A

IRRIGATION ENGINEER REQUIRED IMMEDIATELY for Sudan, aged 28-36, preferably unmarried; first-rate technical qualifications and practical experience, expert leveller, able make contour plans, design canal regulators, &c. Commencing salary about £750 p.a.—Address full particulars and copies testimonials, to "K.C.," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, London, E.C. 4. 3082 A

MECHANICAL ENGINEERS (London District) REQUIRE energetic MAN with good knowledge of Buying, Stock Keeping, Wages Allocation, Cost Records, and General Technical Office Routine.—Address, stating experience and salary required, 3057, The Engineer Office. 3057 A

SITUATIONS OPEN (continued)

METALLURGICAL CHEMIST REQUIRED AT ONCE for large Iron and Steel Works. Must have good experience in all qualities of Basic Open-hearth Steel, and should have knowledge of up-to-date specification requirements.—Address, 2941, The Engineer Office. 2941 A

MILL MANAGER REQD., Egypt. Prev. Technical exp. Cotton Seed Crushing. Age 30/40, single. Knowledge French.—Apply, LAURIES', Employment Specialists, 28, Basinghall-street, E.C. 2. No preliminary fee. 3114 A

QUANTITY SURVEYOR or MEASURER for Structural Engineering Office in London.—State experience and salary required to Box 506, Hannaford and Goodman, Ltd., 57/59, Ludgate-hill, London, E.C. 3076 A

REPRESENTATIVES on Liberal Commission Basis, able to introduce sale of High-class Lubricating Oils at competitive prices, REQUIRED throughout the country.—Address, 3054, The Engineer Office. 3054 A

STOREKEEPER WANTED for Factory Engineering Store, East Africa; £25 monthly. Unmarried. Three years' agreement, return passage paid.—Address, giving full particulars experience, references, P7765, The Engineer Office. P7765 A

THE ENGLISH ELECTRIC CO. OF AUSTRALIA REQUIRES the SERVICES of a MECHANICAL ENGINEER to Take Charge of Engineering Works in Sydney employing 200 men.

Experience in construction of large Turbo-alternators desirable; should also be familiar with up-to-date methods of Traction Motor Manufacture. Age 35 to 45. Good salary to suitable man, passage paid. Applicants (by letter only) should state age, married or single, and give details of technical education and subsequent experience.

Address, NICHOLSON, at English Electric Co., Ltd., Queen's House, Kingsway, London. P7757 A

TURBINE PUMPS.

WANTED, a Thoroughly Experienced DRAUGHTSMAN as Chief Assistant on Turbine Pumps, to Design mainly Impellers and Passages. Good wage. Excellent prospects to suitable man.—Address, 3086, The Engineer Office. 3086 A

WANTED for a Steel Wagon Shop on the N.E. Coast, an experienced WAGON DRAUGHTSMAN; must be capable of getting out expeditiously details for shops, weights and particulars for estimates. State age, experience, and salary required.—Address, 3060, The Engineer Office. 3060 A

WANTED for General Engineering, MECHANICAL DRAUGHTSMAN. Must have gone through the shops. State age, salary, when commence. Not more than three copies references, not returnable.—Address, 3073, The Engineer Office. 3073 A

WANTED, SMART DRAUGHTSMAN, Preferably with experience in Design of Rolling Mill Machinery.—Apply, stating age, experience, salary expected, and when at liberty, to DAVY BROS., Ltd., Park Ironworks, Sheffield. 3110 A

DESIGNER DRAUGHTSMAN REQUIRED AT ONCE. Experience in Loom or Textile Machines. Position temporary, but may become permanent. State salary, age, and full particulars.—Address, 3069, The Engineer Office. 3069 A

DETAILING DRAUGHTSMAN REQUIRED by Constructional Engineers in London.—Address particulars of experience, age, and salary required, P7756, The Engineer Office. P7756 A

DRAUGHTSMAN REQUIRED, Age About 23, Used to the Design and Construction of Grabs. State experience and salary required.—Address, 3112, The Engineer Office. 3112 A

DRAUGHTSMAN REQUIRED IMMEDIATELY for Small Engineering Works in North London.—Address, stating experience, salary, &c., P7754, The Engineer Office. P7754 A

DRAUGHTSMEN REQUIRED, with Experience in Crane and Structural Work.—Apply, stating age, experience, and salary desired, to HERBERT MORRIS, Ltd., Loughborough. 2959 A

DRAUGHTSMAN, Thoroughly Competent, Modern Furnaces, Design and Practice, Steel and Engineering Works. Reply, stating age, detailed experience, salary required; otherwise application will not be considered.—Address, 3088, The Engineer Office. 3088 A

DRAUGHTSMEN WANTED, Experienced in Marine Engine Details and Pipe Arrangements.—Application by letter only, stating experience, age, and salary required, to YARROW and CO., Scotstoun, Glasgow. 3114 A

DRAUGHTSMAN WANTED, with Experience in the Preparation of Detail Drawings for Structural Steel Work; temporary appointment, may become permanent. State experience, age, and salary expected.—Address, 3102, The Engineer Office. 3102 A

EXPERIENCED and Reliable DRAUGHTSMAN WANTED by Steam Engine and Condensing Plant Builders, West Riding District.—Address, 3059, The Engineer Office. 3059 A

REQUIRED, DRAUGHTSMAN, Experienced in Lay-out of Large Boiler Plants, Mechanical Stokers, and Powdered Fuel, Conveyors, &c. Preferably with some knowledge of gasworks practice.—Address, 3085, The Engineer Office. 3085 A

SOUND MECHANICAL DRAUGHTSMAN REQUIRED by London Firm. Experience in Lay-out of Waterworks and Pumping Plant necessary. Knowledge of Building and Ferro-concrete Construction desirable.—Address, stating age, experience, and salary required, 3055, The Engineer Office. 3055 A

SWITCHBOARD DRAUGHTSMEN.—TWO or THREE First-class SWITCHBOARD DRAUGHTSMEN, with good experience on the Lay-out of Up-to-date Switchboard Apparatus, REQUIRED by Manufacturing Firm in London district. Senior men with first-class ability only need apply.

State age and experience, and address replies to 3061, The Engineer Office. 3061 A

FOREMAN (HEAD) WANTED for General Engineering Works, up to date in modern shop methods, tools, shop costing, and progressing work to date. One with experience in Diesel engines preferred. Only first-class men, giving fullest particulars (briefly), age, wage, and references, entertained.—Address, 3095, The Engineer Office. 3095 A

MILL SHIFTSMAN, with Previous Experience in charge of Stamp Batteries, Amalgamating, Grinding, &c., REQUIRED for Gold Mine, West Africa. State qualifications, age, with copies testimonials.—Address, 3094, The Engineer Office. 3094 A

SITUATIONS WANTED

CIVIL ENGINEER, M.I.C.E., REQUIRES POSITION as RESIDENT ENGINEER at home or abroad. Large experience in sea defence and harbour works, &c. Excellent recent testimonials from eminent consulting engineers. Free now.—Address, 3083, The Engineer Office. 3083 B

SITUATIONS WANTED (continued)

ENGINEER SALESMAN, Having Large Connection throughout the West of England, Swindon to Penzance, would like to get in touch with ENGINEERING FIRMS desiring REPRESENTATION in this area. First-class references given and required.—Address, P7718, The Engineer Office. P7718 B

ENGINEER (35), Last Five Years Representing well-known firm of engineers and merchants, DESIRES CHANGE owing to no likelihood of advancement. Several years senior chief engineer, also experience as surveyor. M.I. Mar. E.—Address, P7751, The Engineer Office. P7751 B

ENGINEER (41) DESIRES POST. Good All-round experience, mech., civil and elec., also new works construction, new schemes, improvements to existing works and machinery; good draughtsman, undertake outside or inside work; temp. post if desired. Moderate salary, highest refs., now free.—Address, P7768, The Engineer Office. P7768 B

ENGINEER, with Connection Among Engineers, Architects and Builders in Ireland, DESIRES to REPRESENT MANUFACTURER of R.S.Js., &c.—Address, P7771, The Engineer Office. P7771 B

ENGINEERING ASSISTANT.—ADVERTISER, aged 40, with English and foreign pre-war experience as well as some experience of the commercial side of engineering, has good knowledge of motor cars and lorries, their spare parts, maintenance and repair, DESIRES POSITION as Engineering Assistant or responsible part in the service department of established firm.—Write, Box 77, Willing's, 30, Kingstreet, W.C. 2. 3067 B

MANAGING DIRECTOR.

GENTLEMAN, M.I.C.E., M.I. Mech. E., shortly completing an engagement which has intimately associated him with the reorganisation of an important industrial establishment by which OVERHEAD EXPENDITURE has been substantially cut, is OPEN to CONSIDER APPOINTMENT. Had previous experience in design, construction, and management of mechanical and electrical works.—Address, 3097, The Engineer Office. 3097 B

MECHANICAL ENGINEER and DRAUGHTSMAN SEEKS POSITION of responsibility, either home or abroad. Wide experience home and abroad of general maintenance and construction work; excellent references; age 35.—Address, P7719, The Engineer Office. P7719 B

PREMIUM APPRENTICESHIP or Similar Position is REQUIRED with good firm in London district by college graduate (A.C.G.I.).—Address, P7767, The Engineer Office. P7767 B

REINFORCED CONCRETE.

ENGINEERS, CONTRACTORS and OTHERS in difficulties over E/C Problems or wishing Technical Assistance in Design or Execution should write P7508, The Engineer Office

Expert help and advice will then be forthcoming. P7508 B

TECHNICAL and COMMERCIAL CLERK, 20 Years' experience with constructional engineers, estimating, buying, general correspondence, DESIRES RE-ENGAGEMENT.—Address, P7760, The Engineer Office. P7760 B

TO Government Departments, Shipping Companies, and Manufacturers.—An experienced Electrical SIGNALLING ENGINEER, A.M.I.E.E., at present in charge of signalling department of large company, DESIRES to negotiate new APPOINTMENT for advancement. Expert in naval gun control and director telegraph instruments, also all kinds of naval and mercantile signalling systems. Fifteen years' experience in the manufacture, installing and testing of this class of work. Has inventive ability, used to development work, efficient organiser and capable of handling men. Would be prepared to consider appointment abroad.—Address, P7753, The Engineer Office. P7753 B

YOUNG GENTLEMAN (24) SEEKS POST with good firm. Qualified patternmaker and 12 months' machine shop experience, good education and technical ability; handicraft qualifications; Board of Ed. and C. and Guilds Exams; ex. refs.—Address, P7745, The Engineer Office. P7745 B

DRAUGHTSMAN (Not a Specialist), but with All-round wide experience of mechanical, electrical, and structural work, DESIRES SITUATION, London district preferred.—Address, P7763, The Engineer Office. P7763 B

DRAUGHTSMAN (22), Shop Experience, 3 Years D.O., good knowledge of mathematics, general engineering, REQUIRES a PROGRESSIVE POSITION.—Address, P7748, The Engineer Office. P7748 B

ENGINEER DRAUGHTSMAN, Age 38, Competent designer, SEEKS ENGAGEMENT; 14 years' D.O. and 8 years' works experience leading draughtsman; good technical knowledge, motor vehicles, general engineering, and jig and tool design. London district.—Address, P7766, The Engineer Office. P7766 B

JUNIOR MECHANICAL DRAUGHTSMAN (Age 18½), 3½ years' D.O. exp. and 3 years engineering school. London district.—Address, P7743, The Engineer Office. P7743 B

STRUCTURAL DRAUGHTSMAN REQUIRES POST, home or abroad. Competent design and detail, first-class technical education, 8 years works and D.O. Good references.—Address, P7758, The Engineer Office. P7758 B

FOREMAN PATTERNMAKER, Experienced in high-class work, marine, motor, electrical, 8 years charge last berth in well-known engineers, SEEKS ENGAGEMENT; age 40. Would invest £300 in firm.—Address, P7761, The Engineer Office. P7761 B

POSITION as FOREMAN PATTERNMAKER; well up in latest economical methods; good references.—Address, P7769, The Engineer Office. P7769 B

ENGINEER TOOLMAKER, Bench or Other Work; 5 years' indentureship, passed 3 years' technical courses.—88, Burges-road, East Ham, E. 6. P7755 B

PATTERNMAKER SEEKS RE-ENGAGEMENT; practical experience in all branches wood, plaster and metal patternmaking and casting, designing, plate and machine moulding for repetition work, &c. Used to controlling large numbers of men; head foreman in sole charge close on 9 years; reference.—Address, P7747, The Engineer Office. P7747 B

COMMERCIAL RECONSTRUCTIONS LTD.,
1, POST OFFICE CHAMBERS, DERBY.
Manufacturing and Financial Consultants.

Expert Assistance on all works, technical and commercial problems. Production, Costings and Sales. Businesses reorganised and reconstructed. Capital Issues and Finance. Ex.

PARTNERSHIPS

PARTNERSHIPS ENGINEERING AND BUSINESSES.

Wheatley Kirk, Price & Co.
46, Watling Street, London, E.C. 4.

Established seventy years.

AGENCIES

BOLTS AND NUTS.—AGENCY REQUIRED Good connection.—COOPER and CO., Abbey House, Victoria-street, S.W. 1. P7742 D

FIRM of MANUFACTURERS' AGENTS, with central offices in Newcastle-on-Tyne, are DESIROUS of ARRANGING further LINES, steel construction preferred; good existing connection; allowance and commission basis.—Address, 3046, The Engineer Office. 3046 D

LONDON SALES AGENTS, with Established Connection amongst manufacturing engineers and merchants, DESIRE other AGENCIES for suitable Components or Metals.—Address, P7752, The Engineer Office. P7752 D

REQUIRED for Birmingham and District, Good AGENT on sole commission basis, for sale of well-established material-handling machinery.—Address, 3113, The Engineer Office. 3113 D

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter. and B.Sc.) personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Assoc. M. Inst. C.E., M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams. Courses may commence at any time.—8/11, Trafford Chambers, 58, South John-street, LIVERPOOL. Ex. E

ENGINEERING EXAMINATIONS.—Day, Evening, or Correspondence Courses of Preparation for all Examinations. Thousands of successes during the past eighteen years.—G. P. KNOWLES, M.R.E., B.Sc., A.M.I.C.E., &c., 39, Victoria-street, Westminster, S.W. 1. Ex.

TUITION BY POST.—Inst. C.E. and I. Mech. E. Enrol now for next Exams.; 100 per cent. passes last examination. Reinforced Concrete, new comprehensive course under expert engineer, £3 3s. Write for particulars.—PENNINGTONS, University Tutors, 254, Oxford-road, Manchester. Estab. 1876. Ex.

MISCELLANEOUS

ENGINEERS, Established London Thirty Years, DEVELOP Technically and Commercially Sound ENGINEERING IDEAS on mutual basis.—Communicate first instance to Box E. 466, c/o Dawson's, 121, Cannon-street, E.C. 4. 2858 I

IF YOU REQUIRE
DIVIDING HEADS for MILLING,
ROTARY TABLES for
SLOTTING and MILLING.
Write to
THE WHEELER MNFG. CO. Ltd.,
6F, Trench Crossing, Wellington, Salop.

PATENTS

PART or WHOLE (Part Preferred) of Important PATENTS FOR DISPOSAL. Now before Ministry by request, but adver tiser has a free hand.

For increasing engine power from waste products. Either aerial, marine, motor, or transport. First-class work for any shop. Engineer, M. Inst. M.E.
Address, P7764, The Engineer Office. P7764 B

THE PROPRIETORS of PATENT No. 100,686 "Diminishing Recoil of Guns" are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE and otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to J. E. EVANS-JACKSON and CO., Patent Agents, 57/60, Holborn-viaduct, London, E.C. 1. P7689 B

THE PROPRIETOR of PATENTS Nos. 144,123 and 152,945, both for

"IMPROVEMENTS IN DEVICES FOR SANDPAPERING OR POLISHING FLOORS AND LIKE SURFACES,"

is DESIROUS of DISPOSING of the PATENT RIGHTS or of NEGOTIATING for the GRANT of LICENCES to work thereunder.

Communications should be addressed to
F. W. GOLBY, Patent Agent,
Late of His Majesty's Patent Office,
3, John-street, Bedford-row, London, W.C.1.
3018 B

THE PROPRIETOR of BRITISH PATENT No. 15,664/11, for "A New or Improved Manufacture, consisting of a Cooked Digestible Chocolate and the Machinery and Process for Producing Same," DESIRES to INTRODUCE his INVENTION to the notice of manufacturers and others with a view to the invention being worked commercially under licence or otherwise.—All communications to be addressed to JENSEN and SON, Chartered Patent Agents, 77, Chancery-lane, London, W.C. 2. 3020 B

THE PROPRIETOR of BRITISH PATENT No. 125,553, dated August 12, 1918, relating to "Axle Housings for Motor Vehicles and their Manufacture," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 3026 B

FOR HIRE

FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Deep Wells, &c., 2in. to 24in. dia.—R. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No., 978 Hop. 822 A

FOR SALE or HIRE, ELECTRIC MOTORS, from 30 to 300 H.P.; PORTABLE STEAM ENGINES, from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 37, Queen Victoria-street, London, E.C. Tel., City 3938. Ex.

For continuation of Small Advertisements see page 3

A Seven-Day Journal

Foreign Markets.

DURING the past week one of the leading authorities on naval construction in France expressed the opinion that the time had come when special facilities should be offered to British manufacturers of shipbuilding material and machinery to provide what was necessary for a revival of the French shipbuilding industry. So many new shipyards were established during the war that even in normal times there would not be enough work to keep them all employed, and now that business is absolutely stagnant and a plethora of vessels encumbers the ports there can be no hope for the industry unless it can build ships for foreign countries. Notwithstanding the supposed advantages of a depreciated currency in reducing manufacturing costs, French makers of ship plates and other material are unable to sell at a figure low enough to permit of the shipyards competing for foreign trade. The cost of such material delivered to the shipyards is higher than the cost of British material, exclusive of the import duties, and it is, therefore, suggested that rather than allow the industry to stagnate it would be preferable to permit of the free importation of British material for the construction and equipment of ships to be sold abroad. The same argument applies, in a less degree, to other industries which find production costs steadily increasing with the higher wages and charges resulting from a falling currency.

A New Aero Engine.

LAST September we recorded in the Journal that Peter Hooker, Limited, of Walthamstow, was developing a new form of aero engine, but that the Air Ministry, while greatly interested in the design, was prevented from giving the firm a trial order by virtue of a Treasury ruling which prohibited a Government order being placed with a firm in liquidation—a condition in which this company found itself by no fault of its own and solely as an after effect of the war. The difficulties were eventually, we believe, cleared away, and an order was placed. It is now reported that the engine in question, known as the Stromboli, was introduced by an Italian engineer, but that it has been re-designed and developed until to-day it is virtually a British production. It is said to have six cylinders and a total output of 1500 horse-power, and that preliminary trials have already been carried out with a single cylinder. It may be pointed out that if these figures are correct the engine will represent a very great leap forward in aeronautical engineering. Each cylinder, it will be seen, is, apparently, to develop 250 horse-power. In the largest aero engine at present in use—the Napier 1000 horse-power "Cub"—sixteen cylinders are used; that is to say, each develops just over 62 horse-power.

Standardisation.

AT the fifth annual meeting on Thursday of last week of the British Engineering Standards Association, the chairman, Sir Archibald Denny, once more emphasised the unsatisfactory position of the Association from a financial point of view. A deficit of £1700 odd has now to be faced, and the hope has been expressed that the Government and those engaged in engineering and allied industries will assist in putting the Association's finance on a more stable basis. The work of the Association is performed by some two thousand engineers who give their services free of charge. It is not a profit-making body. The standardisation movement is rapidly spreading throughout the world, and it would be greatly to our disadvantage if, through the lack of a comparatively small amount of additional financial assistance to the British organisation, the standards proposed by other countries should become generally adopted. As an illustration of the spread of standardisation, it may be said that at a recent unofficial conference in Switzerland of the secretaries of standardising organisations thirteen different countries were represented, whereas the previous conference, held in London in 1921, was attended by only seven.

Wireless and the Weather.

THE great thunderstorms which visited a wide area of this country during last week were of such unusual intensity and character that many have sought to account for their occurrence by the presence of exceptional conditions. As in most areas the storms were the first which had occurred since wireless broadcasting was begun on a public scale, it was inevitable that some should endeavour to establish a connection between the two facts, particularly as for a long time the public seems to have had it firmly fixed in its mind that wireless telegraphy definitely affects the weather conditions. There are, of course, no known scientific grounds for suggesting that wireless telegraphy can influence the weather. On the contrary, the influence is all the other way, and even if we suppose that in this matter action and reaction are equal, we have still to remember that the quantity of energy represented in a day's wireless transmission is an exceedingly minute fraction of the energy—hydraulic and electrical—liberated in a thunderstorm. The member of Parliament who asked the Postmaster-General whether he had any evidence to show that the great storm over London on the night of Monday of last week was in any way "due to the presence of the large number of aerial wires in the neighbourhood," may, therefore, rest assured that Sir L. Worthington-Evans' reply to the effect that he had no evidence supporting "his hon. friend's interesting suggestion," has the support of science. In this connection it is interesting to note that, according to the report of the London fire-brigade, there was only one instance during the storm in which a house was struck as a possible result of the presence of a wireless aerial.

A Years' Civil Aviation.

THE annual report—covering the period from April, 1922, to March, 1923—on the progress of civil aviation, issued by the Air Ministry at the end of last week, records a considerable increase in the total air traffic, although it is added that the increase on the London-Paris traffic did not come up to expectations. Air transport flights—internal and continental—made by British machines, numbered 4000, and represented a total mileage of 778,000. The number of passengers carried during these flights was 11,460, while the cargo amounted to 216 tons. The total number of cross-Channel flights was 5137, and of them 2965 were made by British machines. The passengers carried totalled 13,172, and of them 10,066 chose to travel on British machines. Thus, while the British machines represented 57.7 per cent. of the total, they took 76.4 per cent. of the passengers. One passenger was slightly injured in a collision on the ground, but for the second consecutive year no passenger was killed. The efficiency of the services has now reached the figure of 92 per cent.

The Tooting Railway Bill Rejected.

THERE is no question that main line railway companies are not in a position to handle dense passenger traffic with the ability and readiness of the Underground people. Residents, therefore, in the district that was to be served by the proposed extension of the City and South London Railway from Clapham Common through Tooting to Morden and thence over the Wimbledon and Sutton Railway, must regret the rejection by the House of Lords' Committee of the Bill for that work. As, however, Sir Herbert Walker said that he would be willing to allow the new line to be joined on to the Southern Company's Tooting and Wimbledon line at the former place, there is yet hope for the residents in that area. It may be added that as soon as the Wimbledon and Sutton Railway scheme was foreshadowed, the Brighton Company put on a through service of trains between these points, but it was withdrawn during the war.

Motor Vehicle Research.

WE have received a copy of the annual report of the Research Association of British Motor and Allied Manufacturers—a report covering the year ended March 31st, 1923; that is to say, the second full year of the Association's active existence. The Association now comprises thirteen well-known firms engaged in the manufacture of motor vehicles, together with six firms in the position of associate members which are interested by virtue of the supply of materials—principally springs—in the motor industry. As is the case with most other research associations, the progress recorded is somewhat indefinite, although there is little shadow of doubt that in time the work now being prosecuted by and for the Association will prove of important advantage to its members. Few of the researches originally planned have as yet been completed, but a list of the principal subjects which have been or are being investigated shows that the range covered is very wide and of general interest. Of the principal investigations completed or in progress we may mention those on suspensions, carburation, radiators, engine balancing, gear-box noise, die casting of non-ferrous metals and cast iron cylinders.

Westminster Hall.

AFTER a period of eight years spent in the strengthening and repairing of its wonderful old hammer-beam roof, Westminster Hall was re-opened to the public on Tuesday, when the King formally caused the great north doors to be thrown open. The destruction wrought by the larvæ of the death-watch beetle in the oaken members of the roof during the five hundred odd years since it was erected by Richard II.'s fine old master carpenter, Hugh Herland, caused repairs to be undertaken on four previous occasions, namely, in 1663, 1747–1748, 1821 and 1850. Those repairs were not invariably executed in the light of a full knowledge of the complex principle upon which the roof was designed, and, in some cases, they weakened rather than strengthened the structure. The repairs which have now been completed under Sir Frank Baines, of the Office of Works, have resulted in less than 10 per cent. of new wood being worked into the roof. The structure is now virtually carried by an all but completely hidden skeleton of steel work, which, from below, leaves the appearance of the roof unaltered. It is of more than passing interest to note that the work of preserving this ancient roof was prosecuted slowly, but continuously, during the whole of the great war when the nation's thoughts and energies were chiefly bent on destruction.

Sheffield Steel Products.

WHEN the shareholders of Sheffield Steel Products meet in London on the 27th inst., a very drastic reconstruction scheme will be submitted for their approval. No less than £2,007,666, it is proposed, should be written off the share capital as lost. Each £1 preference share under the proposed scheme is to be written down to 10s., and each of the 1,730,700 £1 ordinary shares are to be reduced to 1s. The capital will then stand at £450,035, as compared with the present figure of £2,457,701. In addition, it is proposed to cancel the arrears of preference dividend which have accumulated since November, 1921, to reduce the rate on the preference shares from 10 per cent. cumulative to 5 per cent. non-cumulative—with, however, a participation in surplus profits—and to cancel the guarantee given by the company in connection with the preference shares of the subsidiary undertaking known as Sheffield Steel Products (Stores).

The Circuit of Britain Air Race.

THE second annual race for the Cup offered by the King in connection with a competition involving a flight over a closed circuit of 809 miles, was begun last Friday and finished last Saturday. As in the previous year's contest the course set was for the first day from London to Birmingham, Newcastle and Glasgow; and for the second day from Glasgow to Manchester, Bristol and London. Of 17 entrants, 14 actually started, 11 completed the course to Glasgow, and 7 finished the whole to London. The winning machine, a Siddeley "Siskin," with a 325 horse-power air-cooled Jaguar engine, was piloted by Mr. F. T. Courtney, and completed the whole course in a total flying time of 5 hours 25 mins. 27 secs. The runner-up being Mr. A. J. Cobham on a DH9 450 horse-power Napier machine, with a total flying time of 5 hours 35 mins. 25 secs. It may be noted that while the number of starters was smaller this year than last the percentage of those who finished the whole course was the same, namely, 50 per cent. The winner's time showed a marked improvement, being 1 hour 7 mins. 23 secs. less than Mr. Barnard's figure last year.

The Gas Light and Coke Company.

ON Tuesday representatives of various London municipalities and other bodies visited the Gas Light and Coke Company's Beckton works at the invitation of the governor and directors. The company was organised 111 years ago, and has now a capitalisation of 30 million pounds sterling. Its annual output amounts to 36,000 million cubic feet of gas, and its employees number 15,000, and between them own half a million pounds worth of the ordinary share capital. Its consumers number 900,000. The distributing mains have a total length of 2755 miles. At the unloading piers 1,300,000 tons of coal are landed in a year. There are over 4000 retorts at the works, and in one retort house the largest possibly in the world, 7½ million cubic feet of gas can be produced per day. The water-gas plant comprises nine units, each with a capacity of 3 million cubic feet per day. In the course of a year the works treat for the recovery of by-products about 17 million gallons of tar and 55 million gallons of ammoniacal liquor. The water supply is obtained from the Thames, and is clarified in rapid filtration plant able to deal with 4 million gallons per day.

Trade Reconstruction.

THE occupation of the Ruhr is both political and economical, and, therefore, offers a much more serious problem than if it were merely one or the other. Nevertheless, the political character of the occupation is viewed with a certain distrust by a large section of the industrial community in France, which is suggesting that the only way out of the difficulty is for France to negotiate a compromise with Great Britain whereby the former country would maintain certain political advantages and Britain would be granted such economical concessions as are necessary for trade activity and a diminution of unemployment. The time has come, it is held, when a serious attempt should be made to arrive at a general commercial understanding, for all over the Continent industrial enterprise is paralysed by the currency fluctuations, and both Belgium and France are prepared to negotiate arrangements that will permit of a general trade recovery and assist in a stabilisation of finance. So far as France is concerned there can be little hope of settlement unless the problem is dealt with in its various phases—political, economical and commercial; and once the way is prepared for a British participation in European reconstruction a trade revival should follow as a matter of course.

The St. James's Park and Other London Lakes.

No. I.

IT will be within the knowledge of a large proportion of our readers that, as a war measure, the ornamental lake in St. James's Park was—saving that portion of it known as the Duck Pond—drained dry early in 1915, and that a portion of the site it occupied was used for the erection of temporary buildings required for war purposes. The buildings were not removed until last year, and the lake remained empty for considerably over seven years. At the present time the work of reconditioning the bottom so as to fit it again for holding water is nearly completed, and it is proposed in the present article to describe the operations and to explain why they were necessary. At the same time, since the question is of no inconsiderable interest, advantage will be taken to refer to the history of the lake, to the old watercourses which originally ran through the bed which it occupies, and to the water pumping plant which feeds not only it but also the Serpentine, the Round Pond in Kensington Gardens, the lake in Buckingham Palace grounds, and the fountains of the Victoria Memorial in front of the Palace, &c.

FIG. 1—MAP SHOWING DIRECTIONS TAKEN BY THE TY-BOURNE AND THE WEST-BOURNE

HISTORY OF THE LAKE.

The St. James's Park lake was constructed in its present form in the years 1855–56. In early times the position which it occupies was covered by a marsh bordering on the Thames. Streams from the high ground to the north discharged into the marsh and formed channels for their passage to the river. The most considerable of these streams was the Tyburn, which is described as having two main sources, (*a*) the Shepherd's well, which rose at the top of what is now Fitzjohn's-avenue, and (*b*) a spring on the site of Belsize Manor House. The streams from these two sources met and flowed in a single channel, which was, further down its course, joined by another tributary which rose in or near what are now the Zoological Gardens. Further on still the stream ran down Marylebone-lane—which was formed on its left bank—across Oxford-street near Stratford-place to the west of Bond-street by the foot of Hay Hill, across the lowest part of Piccadilly, and through the grounds of Buckingham Palace. Beyond that point it divided into three arms, the first of which ran alongside Vauxhall Bridge-road, crossed the latter and entered the river a little above where Vauxhall Bridge now is. The second arm ran through the grounds of Westminster Abbey, while the third followed the line of the present lake, crossed what is now Horse Guards Parade, and found its way into the river just below where Westminster Bridge now comes. From old prints it is evident that numerous subsidiary channels in addition to those mentioned also existed. The accompanying engraving—Fig. 1—is a composite map compiled from various sources of information. It shows the courses not only of the Tyburn, or Ty Bourne, and of the West Bourne, but also those of other streams with the streets and roads as they now exist superimposed.

About 1660 a portion of the arm of the Tyburn, which is mentioned above as having followed the line of the present lake, was converted into an ornamental water in the form of a straight canal with parallel banks which ran the full length of the lake as it exists to-day. The work appears to have comprised little more than a trimming of the banks of the stream and the planting of trees. At the south-east of the canal a number of subsidiary watercourses were linked together so as to form a duck quay or decoy. The arrangement of the park, as it was at the time, is shown in Fig. 2, which has been prepared from an old print. The various streams flowing into this area were used, more or less, as open sewers. They were, subsequently, partly covered in and partly diverted into the main sewers.

At the beginning of the nineteenth century, following on the acquisition of Buckingham House as a residence for the Sovereign, further developments took place, part of which was an alteration in the lay-out of St. James's Park and a modification of the ornamental water. It is probable that at the time the canal had become foul owing to the failing supply of running water and to continued pollution. At any rate, at that time, or prior to it, a conduit was laid which linked up the lake with the Serpentine in Hyde Park, which was not, of course, at that time a lake as it is now, but was evidently a meandering stream fed from springs and from the Westbourne which flowed from Hampstead through Bayswater. This conduit was used as a source of supply to the new lake. The latter was formed on the site of the old canal, and was completed about the year 1826. It had practically the same shape as has the lake as it exists to-day, though the plans in existence show two islands at the east end. Its form was, to some extent, determined by the directions taken by the old watercourses. The islands, both at the west and east ends, were artificial. The top water level of the lake when first made is given as 5ft. below Trinity high-water mark, or 7.48ft. above O.D. There is no evidence to show the method employed to drain the lake, but it is recorded that it could only be reduced by 2ft. 6in. below high-water level.

By 1855 the state of the lake had become so filthy as to constitute a source of danger to health, and orders were given for the construction of an outfall sewer to run from its east end, through the Horse Guards archway to the Victoria sewer, in order that it might be drained. The sewer was duly constructed and, when the lake was emptied, "water continued to flow in rapidly from the surrounding ground. On digging to a depth of 2ft., the ground was found to be completely saturated and the soil composed chiefly of partly decayed vegetable matter, and in other places strata of sand and gravel. On digging above 2ft. into the ballast in the bottom of the lake, water was found to rise strongly during flood tide." It was, therefore, considered necessary to drain the subsoil, and "large drain pipes" were laid on the north and south sides of the lake. These pipes discharged into a sewer, the outfall of which was in the Thames. It is remarked in the report from which the foregoing extracts have been taken, that "should the provisions of the Metropolis Act of 1855 be carried out and the main drains made for the purpose of intercepting sewage now flowing into the Thames, all chances of back-flow will be obviated." These drains were constructed when the Embankment was made, and their effect has been far-reaching.

Some slight alterations in the shape of the lake appear to have been made after it was drained. For example, both islands at the east end were joined up to the mainland, and the bottom was covered with concrete made of lime and ballast. The lake, as remodelled and repaired, had a capacity of about 8,750,000 gallons, and it covered an area of approximately ten acres.

RESTORATION OF THE LAKE.

To come down to the present day. When the temporary buildings were removed in 1922, as explained above, an examination was made of the bed of the lake. It was found that the concrete of the floor was badly fissured, owing, partly, to the weight of the buildings, and partly to the drying up of the soil. These fissures were filled with vegetation of various descriptions, and many young trees

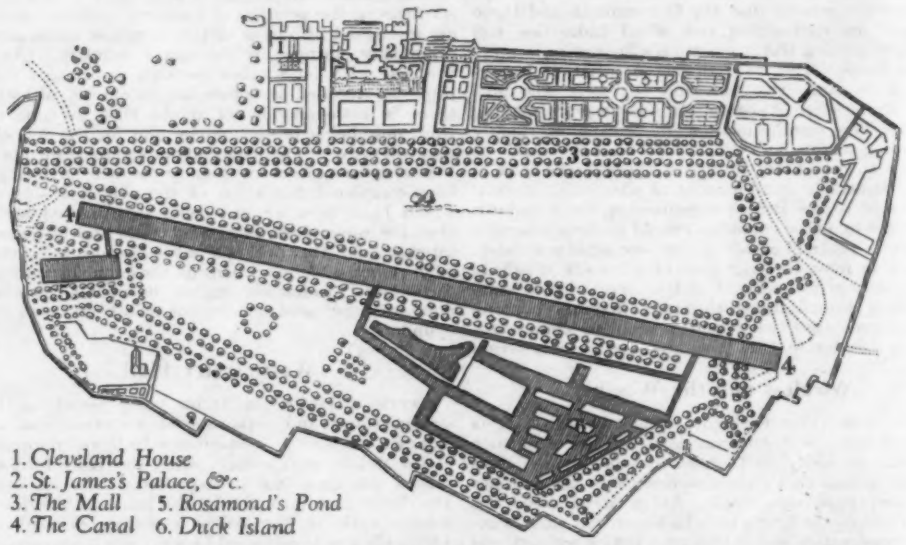


FIG. 2—ST. JAMES'S PARK, SHOWING THE LAKE AS ORIGINALLY FORMED

were beginning to grow in them. In certain areas, particularly at the east end, the lowest point, the concrete had disintegrated in patches, probably owing to the action of frost. Moreover, the banks were very badly broken, the damage being due, in some cases, to the shrinkage of the subsoil, and in other cases to the roots of trees forcing away the concrete from the supporting earth. Some idea of the condition of affairs may be formed from Figs. 3 and 4, which are reproductions of photographs taken of the side and bottom of the lake. A survey established the fact that the north bank was, in places, considerably below the water outlet level—in some places by more than 1ft. It was evident, too, from the fissures between the floor of the lake and the bank that, in parts, the floor had also sunk considerably. A few trial holes were dug and they brought to light the presence of mud and marshy clay below the greater extent of the area, a fact which seemed to give ground for the hope that water might be retained.

In view of the financial conditions which prevailed at the time, it was considered desirable to avoid the expense which the complete reconstruction of the lake would entail. The vegetation was, therefore, removed from the fissures, which were filled with clay. Various other repairs were also carried out. A test was then made by admitting water, but it was found that both the concrete and the subsoil at the east end of the lake were very porous, so that the water escaped freely. The lake, excluding the Duck Pond, had a capacity of about 8,544,000 gallons when filled to overflow level, which is at 6.74ft. above O.D.—or 0.74ft. lower than the top water level of the lake when it was first formed. At no time during the test did the water reach a higher lever than 4.6ft. above O.D., yet the quantity of water emptied into the lake was 27,000,000 gallons. When it was found that no further rise in level could be obtained, pumping operations were stopped, for the rate of loss showed that the banks were in a very bad condition. It was known, however, that a part of the floor of the lake, though it did not retain the water permanently, was comparatively sound.

On completion of the tests, a thorough examination was made of the subsoil, thirty-eight trial holes being sunk and the strata encountered being carefully investigated and recorded. The survey showed a bed of river sand and gravel over the whole area of the lake at depths varying from about 5ft. below to 1ft. 6in. above O.D., the greatest depths being immediately to the west of what is known as Duck Island, though, actually, it is joined to the mainland. The bed of gravel, except for an area at the west end of the lake extending to the east end of the island, and for the north arm of the east end of the lake, was found to be covered with a deposit of marshy clay varying in colour from blue to yellow, and in consistency from sandy clay, containing vegetable matter only slightly carbonised, to peaty clay. This deposit varies in thickness from 8in. to 5ft. 6in., and is found at depths varying from 2ft. 8in. above to 6in. below O.D. It is possible that some of the clay may have been disturbed in the course of the various reconstructions which have taken place. This clay is only slightly tenacious, and where it occurs round the banks it was found to have become hardened and fissured to a serious extent, even at a depth of 4ft. below the floor of the lake. When placed in water it disintegrated entirely and could not be relied upon for retaining water, as the fissures would never close.

A layer of peat and peaty mud containing a large amount of vegetable matter in various stages of carbonisation was found above the clay over the whole area of the lake, except for a small strip at the north-east end, which was probably part of the 1885 alteration. This peaty matter varies in thickness under the floor from 3ft. 4in. to 10in., while under the banks it reaches a thickness of 4ft. 6in. so far as it has been traced. Where the peat lies above the floor of the lake it has lost a large proportion of its water content and can be reduced to powder. The natural result had been a very considerable shrinkage in volume, which left fissures up to 9in. wide, and extending from the surface of the banks to the top of the clay 4ft. to 5ft. below the bed of the lake. These fissures spread in all directions along the banks and explained not only the loss of water but also the subsidence of the banks. The deposit immediately below the floor of the lake is without value as a retainer of water, whatever its thickness may be. Moreover, had nothing been done to counteract it, it was likely to have been a source of danger in future owing to further desiccation and shrinkage taking place.

The problem which had to be faced was different from any which had had to be dealt with in previous operations in connection with the lake. It had become clear that up till 1856 the lake occupied the site of a natural drainage channel or basin, and that the deposits under it were continuously surcharged with subsoil water. With the construction of the Thames Embankment, which cut off the river, and the extension of the system of sewers, the level of the subsoil water had been lowered considerably. Furthermore, the construction and drainage of roads and buildings over the catchment area had materially diminished the amount of water draining through the subsoil. It followed, therefore, that if the alluvial deposits would not retain the water, it would be necessary to construct a watertight basin to do so, since it had become impossible to surcharge the subsoil. The lowering of the permanent water level in the subsoil to a point below the alluvial deposits led to the denudation of those deposits of their contained water and consequently to contraction, and it is anticipated that this contraction will, to some extent, continue. The task was, therefore, to construct a reasonably water-tight basin which would be capable of adjusting itself to future subsidence of the subsoil.

THE CONCRETE "BASIN."

The simplest suggestion—which was considered at the outset—was to treat the whole surface of the floor and sides with a layer of puddled clay. This treatment would have provided a reasonably watertight basin, and have given sufficient elasticity to meet anticipated subsidence. It was, however, open to the following objections :—

(*a*) The depth of the lake would have been reduced from 2ft. to 1ft. at the west end, and there would have been a maximum depth of water of 3ft. compared with 4ft. as at present.

(*b*) The clay would have been eroded under the movement of the water, which, in consequence, would have become muddy and unsightly.

(*c*) The bottom could not have been readily cleaned out—a very necessary process, having regard to the large quantity of leaves falling into the lake each year.

(*d*) Boating would not have been possible, as the boats would have stuck on the bottom near the edges ; and

(*e*) The banks would have been slippery and a source of danger to children who might approach them.

The next suggestion considered was to grout the fissures in the floor of the lake, subsequently covering the whole surface with light mesh reinforcement and rendering the whole waterproof by means of cement deposited by a "cement gun." Had this course been followed, it would have been necessary to renew a large part, if not all, of the banks and not less than 3 acres of the floor of the lake. The floor would not, moreover, have possessed the requisite elasticity to meet further subsidences, and fissuring would have readily occurred, since the concrete which would have been left would not have had much life in it. Hence maintenance charges would have been high and there would have been heavy water charges owing to frequent emptying of the lake for repairs. This method could not, therefore, be recommended as a permanent solution of the problem. Moreover, the large fissures and the peaty nature of the soil ruled out the use of coagulants. It was eventually decided, therefore, that the only satisfactory method of dealing with the matter would be completely to reconstruct the floor of the lake and that course was finally decided upon.

The method of reconstruction adopted may be briefly outlined as follows :—

The old lime concrete covering to the lake bed was broken up roughly to 9in. gauge, partly by manual labour and partly by pneumatic tools. The broken concrete was then pitched and rolled in with a 5-ton roller. This preliminary work revealed several places where the bed was so soft that the mud below the concrete had to be excavated to a depth varying from 2ft. to

FIGS. 3 AND 4—VIEWS SHOWING FISSURES IN THE SIDE AND BOTTOM OF ST. JAMES'S PARK LAKE

3ft. and replaced by hard core. Along the north bank, where the subsoil consisted of peat badly fissured, the peat was cut out down to the marsh clay and hard core substituted. A reasonably firm bed was then formed by the use of 5-ton rollers, and 3in. hard core mixed with Thames ballast was used where necessary to fill in the depressions caused by the rolling. Ten-ton rollers were then employed further to consolidate the bed and additional dressing was applied as required. Finally a 3in. layer of small Thames ballast was spread over the whole area and rolled to proper gradients ready to receive the reinforced concrete lining.

The concreting work, now very nearly completed, consists in providing a slab of concrete 4in. thick, and reinforced by two layers of steel fabric each formed of ¼in. diameter mild steel rods spaced 12in. apart in each direction and wired at the intersections. The concrete is composed of 1 part of Portland cement to 2 parts of sand and 3 parts of Thames ballast graded to pass a ½in. square mesh and to be retained on a $^{3}/_{16}$in. square mesh. The slab is formed to the banks, bird pools, boathouses, drainage channels, &c., and is provided with free joints, at intervals of about 100 yards, in order to reduce the tendency of cracks to develop as the result of the maturing of the concrete and other causes. The concrete is being mixed by power-driven machines and is being deposited by two Ransome distributors assisted by two small mixers. Each day's work is finished against an ending board arranged at right angles to the slab in such a way that a small rebated joint is formed. On restartng work the ending board is removed, and the surface of the rebated joint is roughened, cleaned from all foreign matter, and thoroughly wetted. Before concreting

FIG. 5—CONCRETING THE BED OF THE LAKE WITH DISTRIBUTING TOWER

is recommenced the surface of the joint receives a coat of cement mortar in order to obtain adhesion. Some 800 to 900 square yards of the concrete bed, requiring about 130 tons of gravel, 90 tons of sand, 50 tons of cement, and just over 3 tons of reinforcement are being laid per day. One of the Ransome towers is shown in the illustration—Fig. 5. It is 60ft. high and its present working radius is 100ft. The area to be covered with concrete is about 54,000 square yards. During the progress of the work 6in. test cubes were made with concrete actually in process of being deposited. After twenty-eight days these cubes were tested at the National Physical Laboratory, and the results of the tests made to date show that they cracked under an average load of 2616 lb. per square inch and crushed under an average load of 3115 lb. per square inch.

A valve-controlled outlet drain is formed at the extreme eastern end of the lake where it approaches most nearly to the Horse Guards Parade. By means of this outlet the water in the lake can be completely emptied into the sewer mentioned above as passing through the Horse Guards Archway. The water in the Duck Pond is controlled independently of the main area of the lake, but can be emptied into the above drain by a separate branch.

The work is being carried out under the supervision of the Maintenance Department of H.M. Office of Works, which made the investigations we have described, and decided the method of reconditioning to be adopted. The contractors are Wilson Lovatt and Sons, Limited, of Wolverhampton.

IT is announced that ten dams are to be erected to store the waters in connection with the power schemes of the Quebec Development Company.

The Penistone Works of Cammell Laird and Co., Limited.

No. III.*

ELECTRICAL EQUIPMENT.

THE whole of the electrical energy required in the works is purchased from the Yorkshire Electric Power Company, the current being three-phase, 50 cycles, and at a pressure of 10,000 volts. A switching station, the property of the Power Company, is situated on the works boundary, whence pass two feeders, each having a capacity of 6000 kilovolt-ampères and consisting of two separate three-core paper-insulated lead-covered and armoured cables arranged for split conductor protection, giving a supply to the extra high-tension switchboards situated respectively in the old and new works sub-stations, which are the property of Cammell Laird and Co., Limited.

An additional similar set of cables connects together the two works sub-stations, thus completing a "ring" main, which, in conjunction with a special arrangement of duplicate bus-bars and switchgear, provides maximum protection against total interruption of the supply in the event of feeder or switchgear faults.

The Penistone Works were one of the first in this country to utilise alternating-current motors in connection with steel mill auxiliaries, and the working pressure for many years was confined to 440 volts. When the reconstruction and extensions were taken in hand it was found to be necessary—on account of the greater area to be covered and also the larger motors involved—to arrange for an additional higher pressure, viz., 3000 volts, and at the same time to introduce a direct-current system at 230 volts to meet the requirements of the cranes equipped with lifting magnets and also for the operation of groups of variable-speed machine tools.

The whole of the static transformers required for stepping down the extra high-tension supply pressure to the two values named were manufactured by the English Electric Company, Limited, and, with the exception of those relating to the main drive of the 34in. rolling mill, are placed in one or other of the works sub-stations. In every instance the transformers are of the core type, oil immersed, self-cooling, and fitted with oil expansion vessels so placed as to ensure the cases always being full of oil under a slight pressure. Fire and other risks have been reduced to a minimum by placing each transformer in a separate suitably ventilated brick chamber fitted with iron doors and containing a rail track upon which the transformer stands. The lower part of the chamber beneath the rails is formed into an oil-tight trough, which is filled with fragments of broken stone gradually tapering in size from large portions at the bottom to a fine grade on the surface. This arrangement was adopted to receive the oil in case of accident and assist in damping out any fire should ignition have occurred.

Conversion of the supply to direct current is effected by means of two La Cour motor converters, each of 500 kilowatts capacity, manufactured by Bruce Peebles and Co., Limited. The direct-current switchboards are of the usual black enamelled slate flat-back panel type, while the 10,000-volt, 3000-volt, and 440-volt alternating-current boards are of the well-known Reyrolle ironclad pattern.

* No. II. appeared July 13th.

Apart from the question of pressure regulation and other difficulties encountered as a result of low power factor, always associated with a plant of this description and magnitude, it became necessary some time ago, in consequence of the payments for energy being made on the maximum demand—kilovolt-ampère—system, to consider means for effecting an improvement. The problem has been most satisfactorily solved by the installation of probably the largest group of static condensers in existence. This apparatus was supplied by the British Insulated and Helsby Cables, Limited. It has been in operation about eighteen months and has fully justified the outlay involved.

The capacity of the plant in or relating to the sub-stations is as follows:—Old works sub-stations: Four 750 kilovolt-ampère, 10,000/440-volt, three-phase transformers; four 1220 kilovolt-ampère, 10,000/3000-volt, single-phase transformers (one spare) for 34in. mill drive; static condensers of 576 kilovolt-ampères total capacity operating on 440-volt system; static condensers of 923 kilovolt-ampères total capacity operating on 3000-volt system. The new works sub-station, shown on page 72, contains two 1000 kilovolt-ampère, 10,000/440-volt, three-phase transformers; four 1000 kilovolt-ampère, 10,000/3000 volt, three-phase transformers; two 500 kilowatt, 10,000-volt alternating-current/230-volt direct-current La Cour motor converters; one motor generator set for the tire roughing mill, comprising a 1650 brake horse-power, 3000-volt alternating-current motor coupled to a 1070 kilowatt variable voltage direct-current generator; one motor generator set for No. 1 tire finishing mill, comprising a 1000 brake horse-power, 3000-volt alternating-current motor coupled to a 660 kilowatt variable voltage direct-current generator.

The feeders conveying the electrical energy at the several pressures from the principal sub-stations are run to various auxiliary sub-stations or switching centres in or near to the departments to be served, whence distributing cables pass to the point of use. Generally the feeders and other cables are carried overhead, but in one instance, i.e., those connecting the new works sub-station with the tire shops, are accommodated in the underground subway which passes under the railway cutting. This measures 130ft. long with a cross section 6ft. high and 5ft. wide. Many of the conductors in this subway are bare copper bars of suitable section supported on insulators of special design.

With regard to the electrical equipment in the works, it is sufficient to state that motor drives have been adopted wherever they could be applied. The number of motors installed throughout the works is 151 for crane drives, while 218 are utilised for other purposes, giving a total of 369, representing an aggregate normal rating of 24,345 brake horse-power

The drives of outstanding interest are those relating to the 34in. rolling mill and the three tire mills situated respectively in the old and new works. The 34in. mill as originally installed was driven by a reversing steam engine and consisted of two stands of housings—cogging and finishing—with rolls of 34in. diameter.

With a view to increasing the output from the mill and to meet the different speeds required for cogging and finishing, also to deal with sections requiring power in excess of the capacity of the engine, it was decided to extend the mill by putting down an additional set of intermediate housings, and to drive this new set of rolls, together with the finishing pair, by means of an electric reversing motor, leaving the cogging rolls to be driven by the engine for the time being. As, however, the three stands are arranged in line, it is possible to drive the whole mill, if desired, from either the engine or the motor. When considering the lay-out the substitution of a reversing motor for the cogging end of the mill was borne in mind, and arrangements were made so that the extension of each item of the plant in this manner can be simply and readily carried out.

The motor for driving the roughing and finishing train, with the rest of the electrical equipment, was supplied by Siemens Bros. Dynamo Works, Limited, now incorporated with the English Electric Company, Limited, and is designed for a maximum cut-out turning moment of 225 metre-tons at a speed between 0 and 60 revolutions per minute, corresponding at this latter speed to approximately 19,000 brake horse-power. Fig. 10 shows a general view of the motor, while a drawing of the complete electrical equipment is given in our Supplement. When dealing with long finishing passes which require high speed and relatively low torque, the motor has a further speed regulation from 60 to 150 revolutions per minute by field weakening, and is capable of giving full power throughout this speed range. It will be seen from the illustrations that the motor is of the three-armature design. Two of the machines are bolted together back to back and carried in two bearings. The third armature, which is similar in all respects to the other two, is bolted to a coupling piece fitted to the shaft extension of the second armature, and is carried by an outer bearing. This gives three bearings for the complete machine.

A few leading particulars of the mill motor are as follows:—Weight of each armature, approximate, 45 tons; weight of complete machine, approximate, 320 tons; diameter of shaft extension of each armature, 700 m/m.; overall length, approximate, 45ft.;

overall width, approximate, 18ft.; voltage supplied to mill motor armature, 1400 volts; maximum cut-out current, approximate, 11,500 ampères.

The motor is shunt wound and fitted with main poles, commutating poles and compensating windings, the latter, as well as the armature bars, having moulded-on micanite insulation. The electrical constants are so chosen that the machines can readily deal with the heaviest loading conditions which are in excess of three times the normal rating of the machines. The special mechanical features are the employment of steel throughout, the adoption of a dovetail and double key system of fixing the core plates to the spider to ensure no relative movement—a point of the greatest importance—and the special fixing of the overhang of the armature windings to prevent racking of the latter on reversal.

Each armature is provided with its own short piece of shaft, the mechanical connections between the armatures being made by a special coupling piece of the same diameter as a large flange cast in one with the spiders. The function of the coupling piece is to register the armatures correctly and to permit the insertion of special driving keys so that the bolts holding the armatures together take no portion of the driving stress. This method of coupling the armatures eliminates a through shaft and is considered to give a much more rigid construction with less deflection between the bearings.

The motor, on account of its comparatively slow speed and frequent stoppages, is not self-cooling, and a system of forced ventilation is employed whereby a volume of 40,000 cubic feet of air per minute can be filtered and blown through ducts into air trunks at the back end of the machine and distributed by suitable baffles through the armatures and fields. The control of this motor is on the Ward-Leonard system, and the necessary supply is obtained from a motor generator set with a heavy fly-wheel operating on the Ilgner principle.

This motor generator set supplies the widely fluctuating power required by the mill motor, whilst the demand from the mains is practically constant. This result is brought about by making use of the stored energy of the fly-wheel during periods of heavy load by automatically reducing the speed of the fly-wheel set and re-inserting energy to the fly-wheel during periods of light load, *i.e.*, again speeding the fly-wheel up. On page 72 is shown the fly-wheel set, which consists of a three-phase driving motor, a variable voltage generator, a 46-ton 14ft. 3in. diameter fly-wheel, and a second variable voltage generator.

The whole of the plant is mounted up on a solid combined bed-plate and is supported in five bearings. The motor driving the set is capable of giving continuously an output of 3750 brake horse-power when working on a 3000-volt three-phase supply and running at a synchronous speed of 428 revolutions per minute. The variable voltage generators are designed to supply the mill motor when working in series, the combined maximum output being approximately 11,500 ampères at 1400 volts. The peak demands of the mill motor must be directly taken by these generators, which are consequently again of special construction, the core centres and frames being of cast steel.

The fly-wheel adopted is of the built-up type, and was supplied by Scott and Hodgson, of Guide Bridge. The spider is a steel forging and the complete half rings forming the rim are of cast steel and dovetailed in place by through bolts. The balance of this wheel when running at full speed has been found to be perfect, and the system of forced lubrication employed for the bearings is so efficient that it was found when balancing the wheel on site that the oil under pressure, which is introduced at a slight angle to the shaft, was sufficient to start the wheel rotating. A duplicate system of forced lubrication is employed at a pressure of 200 lb. per square inch for the fly-wheel bearings, the oil pumps in one case being driven by belts from the shaft, and in the other case by a small motor, the latter being intended for use in case of emergency or when starting up the plant. The stored energy in the fly-wheel is 193,000 horse-power seconds, and the working speed is between 420 and 336 revolutions per minute, this speed reduction being brought about by means of an automatic slip regulator. The principle employed is to insert resistance in the rotor of the three-phase motor driving the fly-wheel set, causing a fall in speed at such times as energy is required from the fly-wheel, and to cut it out during periods of no-load in order again to speed up the fly-wheel.

The control of the speed and direction of rotation of the mill motor is carried out by a control lever by a simple backward and forward movement, the central position of the lever corresponding to a state of rest on the mill motor, whilst a movement in one direction or the other gives a forward or reverse direction of rotation on the mill motor, the speed of the motor bearing a definite relation to the position of the lever. This control point is mounted on a platform arranged above the live roll track of the finishing mill. The control lever adjusts resistances in the fields of an exciter set, the armatures of which supply the current for the fields of the main mill motor and variable voltage generators. It will thus be seen that the actual currents to be controlled are extremely small, and the controller is of the simplest design. Mounted alongside the control lever is an instrument desk which carries the necessary instruments to show the driver what is taking place. Thus an ammeter gives him the power demanded from the mill motor, and a speed indicator gives the speed of rolling. A further speed indicator makes him aware as to the speed of the fly-wheel set, and if this is reduced to the lower working limit a red lamp lights up and warns him of the necessity to roll slowly until the speed of the fly-wheel set has been recovered.

In order not to interfere more than necessary with the floor space of the mill, the mill motor itself is the only portion of the plant on floor level, the fly-wheel set, exciter set, slip regulators, transformers, and other plant being erected below ground in a chamber measuring approximately 103ft. by 76ft. The fact of the plant being below ground necessitates special arrangements for ventilating purposes, and in all, three motor driven fans, each capable of blowing 40,000 cubic feet of air per minute are installed, the functions of these being divided out as follows:—One supplies air to the transformer chambers, a second supplies air for the main machinery, the air ducts opening up under the machines of the motor generator fly-wheel set and at suitable points in the floor. The third fan, as previously mentioned, delivers its air to the mill motor. The incoming air is drawn from a distance which ensures comparatively clean condition, but the whole passes through dry air filters of the cloth type, built in a separate chamber away from the plant, from which the dust content is removed periodically.

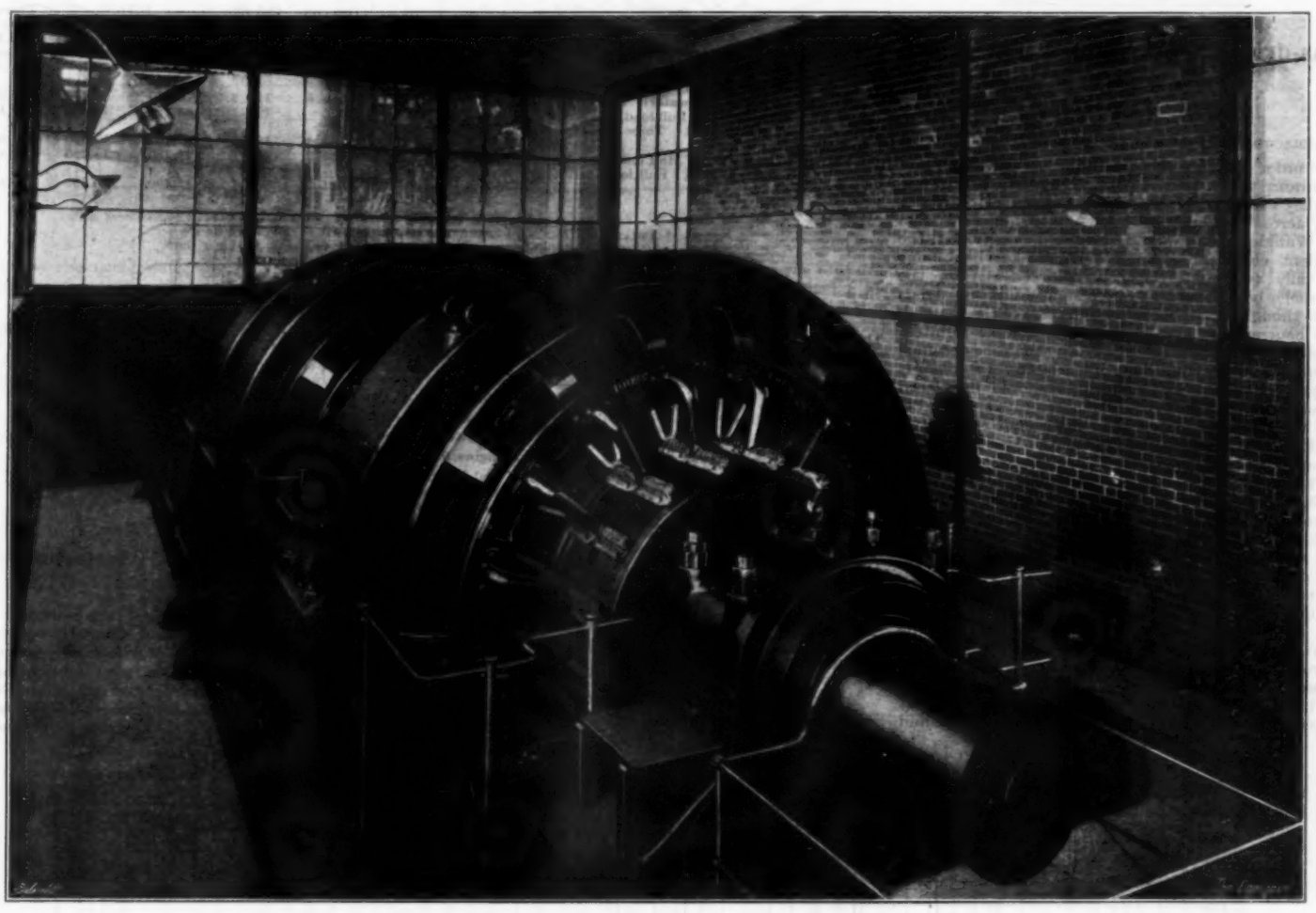


FIG. 10—19,000-H.P. MOTOR FOR 34-INCH ROLLING MILL

The whole of the mill auxiliary plant, including cranes and charging machines, is driven by alternating current motors of the wound rotor type, those applied to the live rollers and other similar drives being of exceptionally robust construction specially built for steel works service. In every instance when the nature of the work demands it, the control is effected by means of contactor type gear centrally situated and operated by master controllers specially placed with a view to convenient manipulation.

The electrically-driven tire mills are three in number, *i.e.*, one for roughing and two for finishing purposes. The equipment on the former comprises two motors, 500 and 800 brake horse-power—driving respectively the inner and outer rolls—the armatures of which are connected in series with the variable voltage generator forming part of the largest motor generator set included in the list of machines fixed in the new works sub-station. Control is effected from a convenient point adjacent to the mill, in a manner similar to that described in connection with the 34in. mill equipment, except that, in this instance, the machines are not arranged for reversal, and, owing to the duration of the rolling process, it is not possible to utilise stored energy from a fly-wheel.

No. 1 finishing mill is driven by a motor which has a normal full load output of 800-B.H.P., and is operated in connection with the variable

voltage generator on the smaller of the two motor generator sets in the new works sub-station. The control is effected in a manner similar to that last described. The speed of rolling in each instance is variable from creeping up to the maximum, depending upon the position of the control lever. In the case of the roughing mill, the speed of the two driving motors is automatically adjusted to the requirements of the moment as demanded by the position of the control lever and the inner and outer diameters of the tire in hand.

No. 2 finishing mill is driven by a 750 brake horse-power 3000-volt wound-rotor type induction motor having a synchronous speed of 500 revolutions per minute. A water-cooled liquid type controller is provided for operating this machine, and the arrangements are such as to permit the machine to be restarted for each tire rolled, or, alternatively, to allow it to run continuously throughout a working shift, in which case the tires are engaged with the rolls whilst rotating. In either case the speed of the motor can be adjusted through a small range during the rolling process by insertion of resistance in the rotor circuit which is effected by a movement of the starting handle. The whole of the electrical equipment for these mills was manufactured and supplied by the Metropolitan-Vickers Electrical Company, Limited.

Gas-driven Alternators for South Africa.

No. II.*

CONTRACTORS' TESTS FOR OUTPUT AND RELIABILITY.

In order to insure that a suitable series of load and endurance trials could be obtained at Messrs. Browett-Lindley's works, the Municipal Council of Salisbury sent across for the trials about 80 tons of coal from the Wankie Collieries, and, as already mentioned, the resident electrical engineer, Mr. Baskerville, came specially to watch the contractors' trials on the Council's behalf, and to make such additional trials as he thought desirable in the interests of the Council. The contractors, Hubert Davies and Co., Limited, were equally anxious that the trials should be designed to prove that the conditions of the contract as regards output, reliability and endurance should be placed beyond dispute before the plant left England, and it was for this reason that they instructed Mr. W. A. Tookey, M.I. Mech. E., to scheme a series of tests and to report to them.

The first of these tests was made on February 13th, 1923, and thereafter the set was under the personal inspection of Mr. Tookey until February 24th. Following it other reliability trials were made under the supervision of Mr. Baskerville, until 70 out of the original 80 tons of coal had been disposed of. A further series of tests was then made on the second set by Mr. Tookey from March 22nd to 27th, 1923, and were followed by paralleling tests. By the courtesy of Hubert Davies and Co., Limited, we reproduce an abstract of Mr. Tookey's report of these interesting trials :—

The tests were designed to give the fullest information possible to the erector in Rhodesia and to the consulting engineer in Johannesburg, as to the conditions prevailing at Messrs. Browett-Lindley's works when the trials there were made. For this reason a special log sheet was prepared by Mr. Tookey and approved by Mr. Baskerville, which provided for the following observations :—

* No. I. appeared July 13th

A.—*Engine.*
1. Revolutions per minute.
2. Position of gas and air regulators.
3. Pressure of air behind regulator on inlet.
4. Pressure in gas inlet manifold beyond governor.
5. Pressure of air inlet manifold beyond governor.
6. Gas pressure before regulator valve.
7. Temperature of lubricating oil in crank case.
8. Inlet temperature of cooling water.
9. Outlet temperatures of cooling water from cylinder jacket and exhaust manifold, from exhaust valve spindle, from top of cylinder cover for each of the four cylinders.

B.—*Two Alternators.*
1. Volts.
2. Ampères per phase for three phases.
3. Main field ampères.
4. Exciter volts and ampères.
5. Kilowatt output.
6. Electrical horse-power output.
7. Brake horse-power output.

C.—*Producers. Two Generators, "A" and "B."*
1. Temperature of steam at inlet.
2. Inlet water temperature at vaporisers.
3. Outlet water temperature at vaporisers.
4. Water temperature at inlets and outlets of each cooler and scrubber.
5. Temperature and pressure of gas at inlets to scrubbers.
6. Temperature and pressure of gas at inlet to dry scrubbers.
7. Temperature and pressure of gas at inlet and outlet of blowers.

D.
1. Gas analysis and computation of calorific value therefrom.
2. Readings from recording gas calorimeter.
3. Determination of gross and net calorific value by Sugg's Calorimeter.
4. Readings from rotary gas meter.
5. Barometer readings; temperature of air (dry and wet bulb).

E.
1. Governor test, speed variations with load suddenly thrown off and put on.
2. Voltage regulation, alternator and exciter temperatures.

TABLE I.—*Summary of Test Results, First Series.*

	K.W.	Output, B.H.P.	Gas consumption, c. ft. per min.	Calorific value, B.Th.U. per c. ft.	B.Th.U. Per K.W.	B.Th.U. Per B.H.P.	Thermal efficiency per B.H.P., per cent.
Trial A, February 13th, 1923. Overload, two hours	336	484	725	115	14,950	10,360	24.5
Trial B, February 13th, 1923. Overload with throttled air, two hours	342.4	493	792	110.5	15,320	10,600	24.0
Trial G, February 17th, 1923. Overload, throttled air and restricted water circulation, two hours	348.6	502	763	107.5	14,100	9,800	26.0
*Trial C, February 14th, 1923. Full load, ten hours	319	461	680	112.4	14,400	9,950	25.6
*Trial E, February 16th, 1923. Full load, ten hours' restricted air and water circulation	302.6	438	643	115.9	14,750	10,190	25.0
Trial D, February 15th, 1923. Half load, two hours	152.8	232.5	494	106.2	21,600	13,550	18.75
Trial F, February 17th, 1923. Three-quarter load, twenty minutes	226.75	333	569	113.2	17,050	11,000	21.9

TABLE II.—*Summary of Test Results, Second Series.*

	K.W.	Output, B.H.P.	Gas consumption, c. ft. per min.	Calorific value, B.Th.U. per c. ft.	B.Th.U. Per K.W.	B.Th.U. Per B.H.P.	Thermal efficiency per B.H.P., per cent.
Trial H, March 22nd, 1923. Overload trial, two hours (restricted air and water)	344	495	710.6	121.3	15,030	10,450	24.35
Trial I, March 22nd, 1923. Full load, half-hour	303.7	439.5	622	124.2	15,280	10,550	24.1
Trial J, March 22nd, 1923. Three-quarter load, half-hour	224.7	330	503.3	127.7	17,160	11,690	21.8
Trial K, March 22nd, 1923. Half load, half-hour	152.3	232	460.3	120	21,760	14,290	17.8
*Trial L, March 23rd, 1923. Full load, ten hours (restricted air and water)	301.1	435.7	621.3	125.1	15,490	10,700	23.8

* TRIAL C.—5152 lb. of coal fed to producer during trial of ten hours.
560 lb. of coal fed to producer after trial = 11.1 per cent.
5712 lb. at 12,900 B.Th.U. per lb.

$$\text{Producer efficiency} = \frac{\text{Heat in gas}}{\text{Heat in fuel}} = \frac{680 \times 600 \times 112.4}{5712 \times 12,900} = 0.62.$$

This is somewhat low owing to delay in cleaning fires after the trial, when gas was burning to waste for about forty-five minutes

* TRIAL E.—4480 lb. of coal fed to producer during trial of ten hours.
476 lb. of coal fed to producer after trial = 11.1 per cent
4956 lb. at 12,900 B.Th.U. per lb. = 4956 ÷ 3026 = 1.64 lb. coal per K.W.

$$\text{Producer efficiency} = \frac{\text{Heat in gas}}{\text{Heat in fuel}} = \frac{643 \times 600 \times 115.9}{4956 \times 12,900} = 0.70.$$

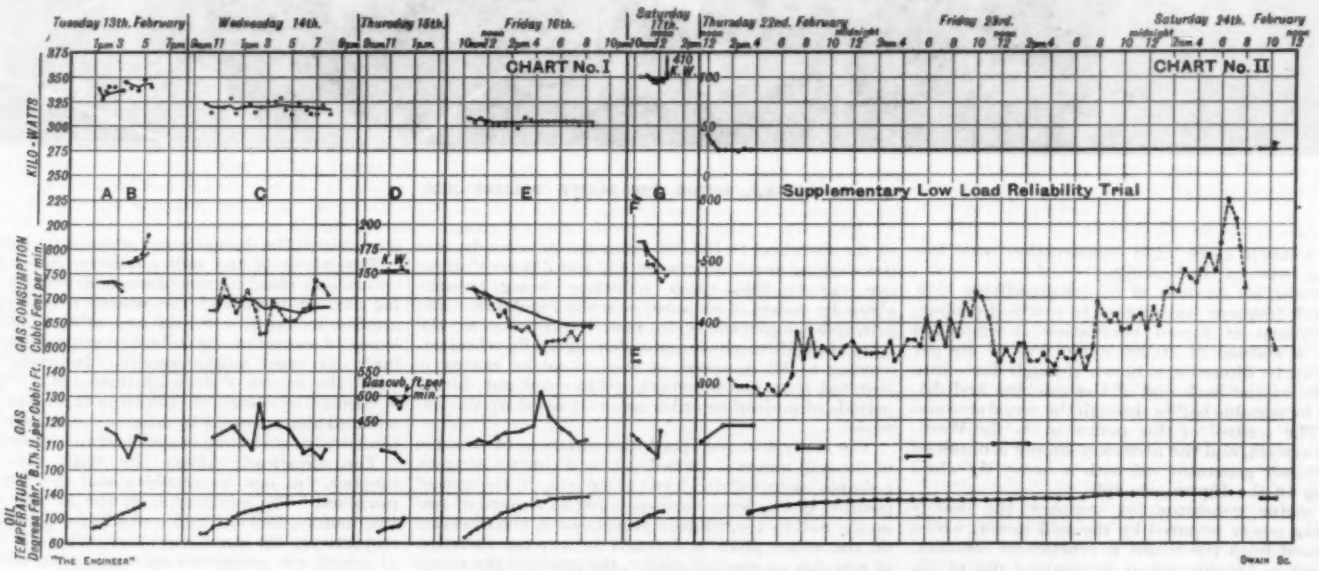
Therefore combined efficiency per B.H.P. producer and engine, 0.70 × 25 = 17.5 per cent.

* TRIAL L.—5544 lb. of coal fed to producer during eleven hours.
allowance as trials C and E of 11.1 per cent. (estimated).
6150 lb. for eleven hours.

$$\text{Producer efficiency} = \frac{\text{Heat in gas}}{\text{Heat in fuel}} = \frac{660 \times 621.3 \times 125.1}{6150 \times 12,900} = 0.65.$$

This is somewhat lower than actual owing to there being two or three periods when the gas was blown to waste for several minutes for adjustment of voltage on water resistance vessels during first hour.

From these logs the principal observations were plotted on squared paper and Chart I.—given in Fig. 5—shows the readings of kilowatts, gas meter differences, gas calorific value, and lubricating oil temperatures for the first series of trials, while Table I. gives the summarised figures and shows the thermal efficiencies obtained, namely, in the neighbourhood of 24–26 per cent. on the brake horse-power basis. Similarly Chart II.—Fig. 6—shows the chief observations made during a supplementary low load trial which had for its chief object the testing of the gas producers for tar elimination, it being considered that to run an engine of 300 kilowatts output for forty-eight hours at 25 kilowatts output would be a very severe test of the producers, as,



FIGS. 5 AND 6—CURVES SHOWING RESULTS OBTAINED DURING THE TRIALS

naturally, if any trouble from tar was likely to occur it would appear at such a continued low load output. Upon referring to Chart II. it will be seen that the gas meter reading differences vary very considerably and show an increase at the end of the forty-eight hours, but this was due to the producers becoming choked and requiring cleaning, a matter more of adept attendance than of design, as was proved by Chart IV. —Fig. 8—which represents a further six-day trial under conditions which Mr. Baskerville had indicated

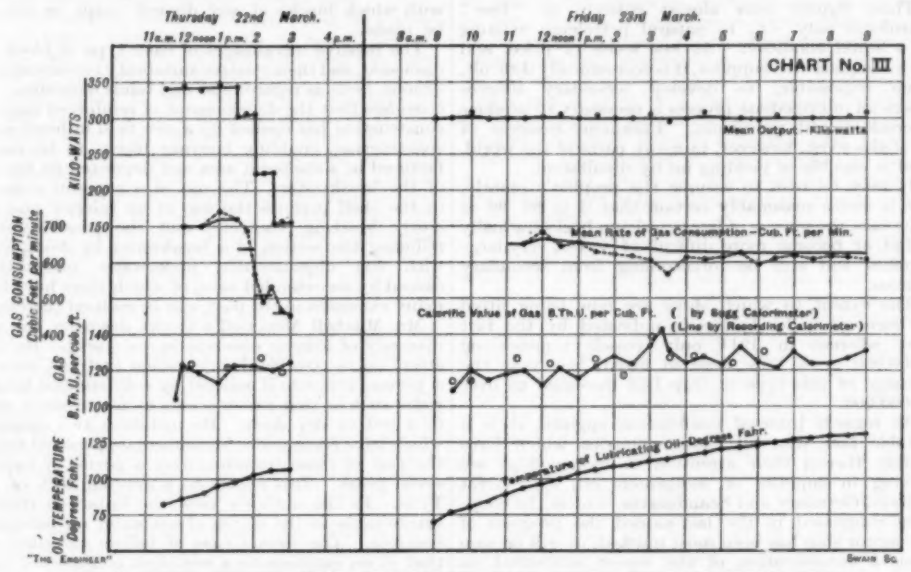

Thursday 22nd March.
Friday 23rd March.
CHART No. III
KILO-WATTS
Mean Output – Kilowatts
GAS CONSUMPTION Cubic Feet per minute
Mean Rate of Gas Consumption – Cub. Ft. per Min.
GAS B.Th.U. per cub. ft.
Calorific Value of Gas B.Th.U. per Cub. Ft. (by Sugg Calorimeter) (Line by Recording Calorimeter)
OIL TEMPERATURE Degrees Fahr.
Temperature of Lubricating Oil—Degrees Fahr.
"THE ENGINEER"
SWAIN SC.

FIG. 7—CURVES SHOWING MEAN OBSERVATIONS MADE DURING TRIAL OF SECOND SET

would be the usual daily operation of the sets at Salisbury. In this case it will be seen that the k.V.A. followed the variations of load that occurred during twenty-four hours. On Chart IV. the gas consumptions are plotted in cubic feet per hour, rising and falling with the load curve. The sequence of producer operation is also shown and indicates the "peak" loads when both producers were in use and at lower loads when one or other was being worked, allowing fires to be cleaned alternately.

summary of figures being given in Table II.; they are comparable with the first series of tests shown in ChartI. and Table I.

In addition to these tests a maximum output trial was made. Under it the set proved capable of generating as much as 410 kilowatts, or, say, 33 per cent. beyond the rated output. This load was held for a quarter of an hour and could, no doubt, have been continued for a much longer period; but Mr. Tookey decided that the duration was sufficient to prove that one set could be relied upon for an excessive output, while the second set was being put into operation in case of emergency.

In order to satisfy Mr. Tookey that the engine was capable of obtaining the outputs under Salisbury conditions special vacuum gauges were put upon two places of the air inlet and one upon the gas manifold. A comparison of the barometer and thermometer readings, according to official returns from Salisbury, Rhodesia, show that throughout the year 1921 the

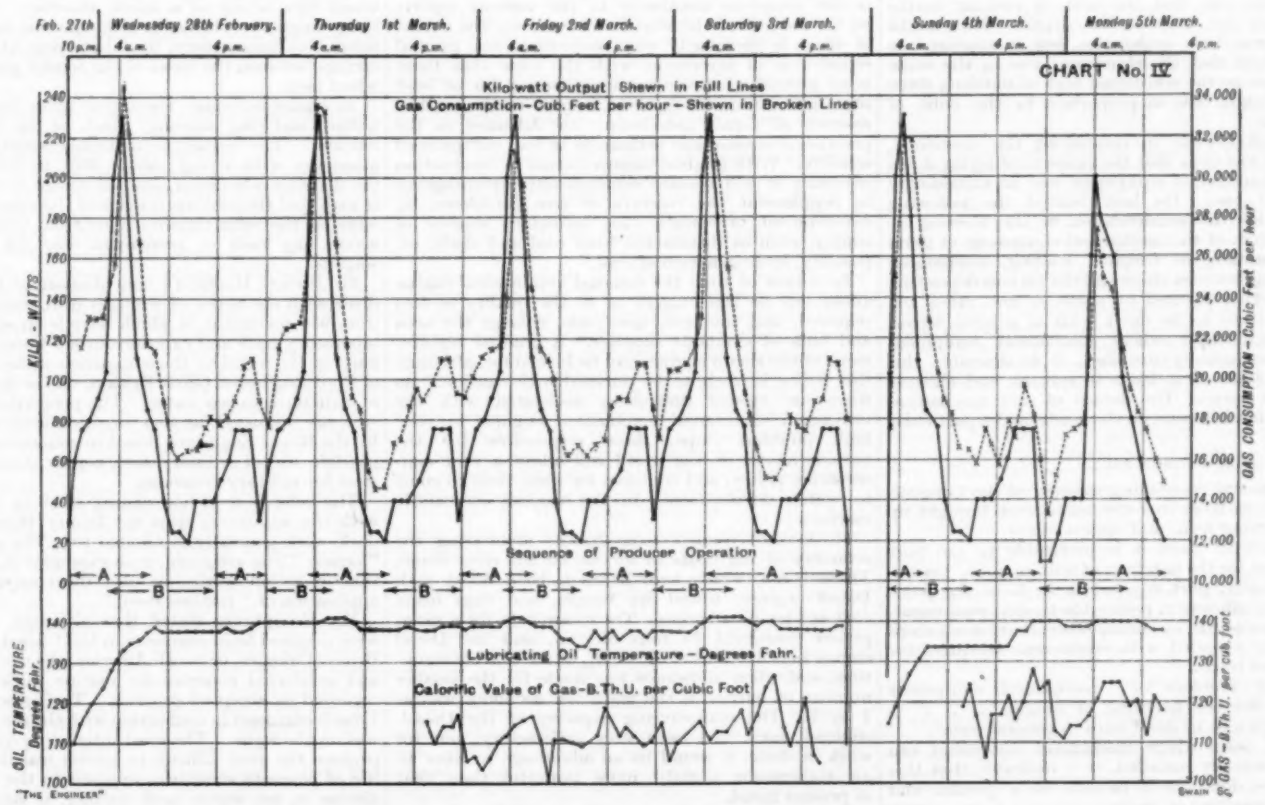

Feb. 27th
Wednesday 28th February.
Thursday 1st March.
Friday 2nd March.
Saturday 3rd March.
Sunday 4th March.
Monday 5th March.
CHART No. IV
Kilowatt Output Shewn in Full Lines
Gas Consumption – Cub. Feet per hour – Shewn in Broken Lines
KILO-WATTS
GAS CONSUMPTION – Cubic Feet per hour
Sequence of Producer Operation
Lubricating Oil Temperature – Degrees Fahr.
Calorific Value of Gas – B.Th.U. per Cubic Foot
OIL TEMPERATURE Degrees Fahr.
GAS – B.Th.U. per cub. foot
"THE ENGINEER"
SWAIN SC.

FIG. 8—CURVES SHOWING RESULTS OBTAINED DURING SIX-DAY TRIAL

As judging from Charts I. and II. the lubricating oil temperature had not reached its maximum, it was plotted on Chart IV., and it is interesting to note that after "peak" loads it reached 141 deg. Fah., falling slightly at the intervals between "peak" loads. Chart IV. also shows the varying calorific value of the gas as recorded by the calorimeter, which probably can be accepted as embodying any extreme that would be likely to be met with at the permanent site, and under the usual operating conditions with native labour. Chart III. exhibits the mean observations made during the trial of the second set, the mean barometer corrected to standard was 25.35in.—varying only between 25.479 maximum to 25.260 minimum—and that the mean temperature was, dry bulb 67.5, wet bulb 59.1, with a mean daily variation of 27.5 and mean relative humidity of 59 per cent.

Under the conditions prevailing at Manchester on the day of the full load trial, February 16th, 1923, the barometer readings were 29.77; thermometer dry bulb, 53 deg.; and wet bulb, 49.5. The corrected barometer would be 29.447, at 32 deg. Fah., allowing for 79 per cent. of humidity—and comparing with standard records of 29.72—and, therefore, calculation showed that the ratio between Manchester conditions on February 16th and the mean Salisbury conditions is as 1 : 0.836. It was decided, therefore, that the engine should be run with the air regulator closed to such an extent that a vacuum of 5in. mercury—comparing with 4.1in. barometer difference as above—should be shown on the gauge at the back of the air regulator; and indicator diagrams taken during the trial with light springs showed that the average volumetric efficiency of each cylinder was 0.79. In this way it was proved that whereas the mean conditions at Salisbury would be approximated with a volumetric efficiency of .836, the conditions under which the engine was run at Manchester represented a further 5 per cent. margin. All the trials, therefore, were made with the throttled air to show 5in. vacuum on the air inlet, while in order to establish an approximation to Salisbury conditions as regards cylinder temperature, the water circulation was controlled so that the temperature at the various outlets was maintained at or about 120 deg. Fah.

The test results were entirely satisfactory in every way, but there is little doubt that still better figures will be achieved at Salisbury when the gas plant will be completed with its regulating gasholder giving automatic control to the volume of gas produced according to the load upon the engine.

International Navigation Congress.

No. III.*

PORT OR SHIP EQUIPMENT.

WHEN the Ocean Navigation Section reassembled the discussion on the relative advantages of shore or ship equipment was continued. The subjoined resolution was presented for discussion:—"In most cases it is preferable to use port equipment for the handling of bulk cargoes. Speaking generally, port equipment is from the point of view of efficiency preferable to ship equipment. It appears to be essential, however, that all ships should be supplied with equipment adequate for their usual trade, but in the case of ships trading regularly between ports furnished with very complete equipment the equipment of the ship may be reduced."

Captain W. F. Purdy asked the Congress to consider the question very carefully before recommending the reduction of ship equipment. Ships could no doubt be lightened from that point of view if the question of handling cargo in port was the only question which had to be considered, but ships were concerned with the sea, and the perils of the deep. Ships got stranded, and in those circumstances the ships' gear was required for salvage operations. The lack of such gear would have an effect on the insurance of merchant ships.

Captain F. Chambers (U.S.A.) supported this view, and the need of ships' gearing in such circumstances was also emphasised by Captain M. H. Clarke, speaking from sea-going experience.

Mr. G. H. Bowden said that there was yet another

* No. II. appeared July 13th.

reason for the maintenance of ships' gearing in a considerable degree of efficiency. In cases of port congestion when ships were unable to obtain a berth it was possible to avoid detention by making use of the ships' gearing for discharging into lighters, and ships plying coastwise would also require gearing at one port, an open roadstead like Port Elizabeth, for example, and would not require it at a port like Durban. The trend of design of the latest type of cargo boats was to fit them with good unloading and loading facilities, notwithstanding that they were plying between ports where there was adequate shore equipment.

Sir John Biles was in favour of omitting from the resolution all reference to the reduction of the ships' gear. In any event, he said, the shipowner would please himself in the matter.

After further discussion the resolution was carried in the following form:—"In most cases it is preferable to use port equipment for the handling of bulk cargoes; speaking generally, port equipment is, from the point of view of efficiency, preferable to ship equipment, but it appears to be essential that all ships should be supplied with equipment adequate for the needs of their usual trade."

The Section then proceeded with the consideration of the character of the equipment to be installed.

Mr. H. J. Deane said that the conclusions which he had drawn up in connection with this branch of the subject were based upon the opinions expressed in the reports generally. No doubt the preference indicated for electric power opened up a controversial question, but the possibility should be borne in mind that electric power might be utilised for generating power in hydraulic and other machinery by the use of the Hele-Shaw transmission gear or other auxiliary appliances. The nature of the appliances to be installed must be governed by the particular requirements of a port. At some of the new sheds at the King George V. Dock at the Port of London, underhung travelling cranes had been installed on the upper floors. These cranes could reach from the quay right across the shed and deliver into vans or railway wagons. They could also be utilised to handle packages, and had been found of great assistance in piling large stores of tobacco which had had to be kept in some of those sheds. The importance of having movable cranes could not be over-emphasised.

Sir John Biles said that one of the objections to the big ship was the difficulty and additional cost of handling cargo in comparison with the small ship. No doubt there was room for improvement in handling general cargo from large vessels. An aspect of the big ship problem which had received attention at the Congress was that the cost of making berths increased as the cube of the depth. This might be hard upon dock authorities, but it appeared to be overlooked that the shipowner was in the same predicament, as the additional cost of building ships of deep draught was in proportion to the cube of the draught.

Sir Ernest Glover, in concluding the discussion, said that it was clear that the problem of laying down rules for character of equipment was an exceedingly complicated one. He had drafted the following resolution for the consideration of the meeting:—"The problem of the mechanical equipment of ports for the handling of freights, loading, discharging and carrying between ships and the various depositing points, whether covered by sheds or not, raises too many questions to be dealt with in general terms. It is evident that where mechanical equipment can be economically installed, it is desirable this should be done, as it leads to quicker and cheaper handling of cargo. The details of such mechanical equipment must depend on the needs of the particular port."

The resolution was adopted.

At the general concluding meeting of the Congress the resolutions from this discussion were brought up in the following form and approved:—

(1) In most cases it is preferable to use port equipment for the handling of bulk cargoes. Speaking generally, port equipment is, from the point of view of efficiency, preferable to ship equipment. It appears to us essential, however, that all ships should be supplied with equipment adequate for their usual trade.

(2) The problem of "mechanical equipment of ports for the handling of freight . . ." is too complex to be dealt with in general terms.

In all cases where mechanical equipment can be economically installed, it is desirable that this should be done, as it permits of a quicker and cheaper handling of cargo.

The details of such mechanical equipment must necessarily depend upon the needs and possibilities of each individual port.

Liquid Fuel for Ships.

In a general report on this subject Professor Sir John Cadman summarised the experience gained with oil fuel for steam raising purposes, or for direct use as fuel in Diesel type engines. He pointed out that most of those who have compiled reports on the subject traverse the same ground. The reporters include Mr. Maximiliano Prado (Chili), Mr. U. T. Holmes (U.S.A.), MM. R. Boris and G. Bricard (France), M. Carlo Baulino (Italy), M. Georges Popesco (Bucharest), and Mr. Gustav Seth (Sweden). It is shown that the production of crude petroleum has more than doubled in the last ten years, the figures being: 1913, 52,000,000 tons; 1922, 117,000,000 tons. One of the writers thinks it reasonable to anticipate an output of 150,000,000 tons by 1930. There seems, in any case, no good reason for thinking that production is yet within sight of its maximum. Quite apart from the areas still steadily producing, enormous areas in South America and elsewhere await exploration and exploitation.

These figures refer almost entirely to "free" petroleum only, *i.e.*, to natural petroleum existing in a liquid condition. At low levels of price, and with adequate well supplies, it is economically difficult, often impossible, to develop secondary sources where an intermediate process is necessary to produce a crude liquid petroleum. Enormous reserves of oil shales exist, however, in many parts of the world. Coal is capable of yielding oil by distillation.

It may be rash to assume the prophet's mantle, but it seems reasonably certain that if in 80, 90 or 100 years, the sources of free petroleum begin gradually to fail, or become more difficult of access, very large supplies will still be forthcoming from secondary sources.

The extent to which ships are now being fitted to burn oil under boilers is indicated by the fact that whereas in 1914 only vessels representing 1,300,000 gross tons were so fitted, last year the tonnage of this type of ship had increased to over 14,000,000.

As regards internal combustion engines, it is a notable fact that all those countries which have mainly turned their attention to motor ships are lacking in supplies of indigenous oil, *e.g.*, Great Britain, Germany and Scandinavia, and in the countries comprised in the last-named the progress of the motor ship has been most marked, as will be seen from a consideration of the report submitted on Sweden. The initial cost of a motor ship is estimated as being some 10 to 15 per cent. higher than a steamer and it has also a shorter life, but these factors are more than offset by the saving in operating costs, said to amount to 30 to 40 per cent. Diesel fuel oil is quoted at a higher price per ton than ordinary fuel oil, and although an increase in the number of motor ships might lead one to expect an increase in the price of this oil, this situation may be met by the development of a larger number of internal combustion engines designed to use a lower grade oil than the present Diesel oil.

The following conclusions were submitted for the consideration of the Congress:—(*a*) Whilst there is not complete unanimity in the various reports on the subject of the world's oil reserves, the extent of which is necessarily very conjectural, the general reporter is in agreement with the view that there is no ground whatever for apprehension for at least some generations to come in respect to the world's reserves of liquid petroleum. (*b*) Advance in the practice of economical utilisation of fuel will proceed steadily. With gradual improvements in combustion efficiency it will become economically advantageous to supplement the reserves of free petroleum by development of certain vast secondary sources of supply, such as distillation from coal and shale, or, possibly, hydrogenation of coal.

In course of time the internal combustion engine afloat will be less exigent as to the quality of fuel required, and this will, *ipso facto*, enlarge the area and bulk of available supplies. A gradual replacement of the steam engine may be looked for, although this policy is likely to be pursued with caution. As there are special difficulties associated with the utilisation of internal combustion engines in very high powered ships, those responsible for the various navies of the world will adopt a very conservative policy, and continue for some time to come to watch developments in the various mercantile marines.

M. Bricard quoted some figures illustrating the economy of tug boats in service on the river Seine. These boats, which had, he said, been fitted with Diesel engines, towed six barges, and tugs using coal as fuel, nine barges. The steam tugs for a given period consumed 35 tons of coal, and the Diesel engine tugs 3.5 tons of oil, or $^1/_{10}$ of the coal consumption, and when allowance was made for the smaller number of barges in the train the economy was as 1 to 7. The manœuvring capacity of the Diesel-engined boats had been very satisfactory, but for work in docks it would be an advantage to have an air compressor slightly more powerful than that at present fitted.

Concrete and Reinforced Concrete.

An interesting general report on the application of concrete and reinforced concrete to hydraulic work was presented by Mr. G. W. Humphreys, Chief Engineer of the London County Council. Fourteen reports were reviewed, including five from Great Britain, two from Denmark, two from Spain, and one each from Belgium, France, the Netherlands, Sweden and Japan. The British reporters are Mr. S. D. Carothers, in the chief engineer's department of the Admiralty; Mr. James Mitchell, civil engineer, Aberdeen; Mr. William Cleaver, resident docks engineer, Newport, Mon.; and Mr. J. Mitchell Moncrieff, consulting civil engineer, London. A report on the corrosion of ferrous metals, with special reference to the action of sea water, by Sir Robert Hadfield, was also presented.

Mr. Mitchell's report deals with "Cement concrete and its application to breakwater construction." His remarks are directed entirely to the construction of works exposed to heavy weather and wave action, and he discusses the desiderata of design in structures exposed to such conditions, stating that Portland cement concrete is eminently suitable for breakwater construction owing to its durability and the facility with which blocks of any desired shape or size can be made.

The relative advantages of each type of block are discussed, and their relative suitability for various conditions, both as regards site and funds available. He considers that the development of reinforced concrete construction has opened up a new field in breakwater construction, enabling buoyant blocks to be manufactured in a sheltered area and deposited on the site of the breakwater. The use of a superior concrete in the shell permits the use of an inferior and less costly hearting concrete, and the possibilities of reducing the section of a breakwater by doing away with the objectionable underwater obstructions caused by an extended base, of which there have been many examples in the past, can be realised thereby.

Mr. Mitchell Moncrieff's report discusses the permanency of cement concrete in sea works. He calls attention to possible disintegration that can occur in a porous concrete if assisted by a differential head of water such as that which occurs at the entrance walls to a wet or dry dock. He instances two examples which have come under his immediate personal notice, the first of these extending over a period of twenty-seven years. This relates to a graving dock on the Tyne. In the author's view the failure is entirely attributable to the action of sea water on permeable concrete. The second case of failure recorded was that of an entrance to a wet dock constructed some years ago where serious trouble had arisen with the side walls and hollow quoins. Bulging walls constituted the defect, and the maximum bulges occurred at or about low watermark.

Mr. Cleaver's report deals with the efficient fendering of concrete walls. He is of opinion that the most efficient method of fendering any dock or wharf is by means of strictly independent timber piles driven in front of the wharf face, so as to leave a minimum space of 4in., and not more than 5in.–6in. between the inner side of the fender pile and the wharf face. The sole attachment to the wharf should be through the medium of a longitudinal capping timber, the space between the fender pile and wharf face acting as a shock absorber. More elasticity might be obtained, although the author considers this unnecessary, by interposing special coiled springs between the head of the fender piles and the wharf face.

As regard moorings, the author gives drawings of a bollard and ring mooring, which he has found very efficient. The bollard is a double-horned one, and alternates with a ring; about 60ft. to 70ft. apart is the distance advocated, and the design of attachment is such that the best use is made of the main structure, while at the same time no ropes from vessels will lie across any rails or permanent way for cranes or wagons.

Sir Robert Hadfield's contribution to the subject deals with the types of wrought iron, steel, and cast iron, 955 specimens of which have been allocated for laboratory tests and exposure to sea water in various parts of the world by the committee of the Institution of Civil Engineers, Great Britain, on the deterioration of structures in sea water. The properties of copper steel are discussed, as also corrosion tests undertaken by the Royal Engineers Board in connection with the possible use of ordinary steel, copper steel, and alloy steel for military pontoons.

The behaviour of non-rusting steel in connection with the appliances used by Trinity House and for dock work generally is alluded to. The qualities of "armco" iron are given, with examples of its application in actual works, as also the composition and application of "rustless steel."

Mr. Humphreys stated that although no reports were received from engineers in the United States, the British Colonies, or South America, the use of concrete and reinforced concrete for marine works could be regarded as accepted practice. The conservatism of French engineers in connection with the use of concrete was on the wane. The most interesting question and perhaps the most difficult to answer was the probable life of concrete structures exposed to the worst conditions in sea water, and, further, if such concrete was reinforced, what effect reinforcement had upon such concrete structures, or indeed concrete structures in any situation, having regard to the facility with which iron, or steel, reinforcements oxidised under ordinary atmospheric conditions.

Monsieur R. Boris referred to the use of concrete tanks for oil storage. Considerable experience was being gained with this type of construction in the United States. Some tanks had been built to dimensions of 110ft. diameter above ground, and these structures had withstood the effects of hurricanes and floods.

Lighting and Beaconing of Coasts.

The general report by Mr. D. W. Hood on the sub-

ject of the principal advances made in coast lighting and signalling and the unification of the languages of maritime signals elicited an interesting discussion. Having regard to the growing importance of the subject, a request was made that at future Congresses the Permanent Association would constitute a separate section for this branch of marine work. Fourteen reports were communicated to the Congress, of which Great Britain contributed five, Belgium, France, Holland, Italy, Japan, Russia, Spain, Sweden and the United States of America one each.

In summarising these reports Mr. Hood drew attention to many important aspects of recent developments. Mr. Hood himself dealt with recent achievements in lighthouse practice which stand to the credit of Trinity House. Mr. A. E. Butterfield put forward proposals for a uniform system of lighting estuaries and tidal rivers. Mr. Alan Stevenson dealt with modern developments designed to assist the navigation of vessels during fog, and Captain Harold Browne dealt in detail with the radio acoustic method of fixing the position of a ship at sea. Mr. George R. Putnam, the Commissioner of Lighthouses in the United States, gave an account of the work of his department during the past ten years. The chief advances have been in the use of radio fog signals and in the number of lighted buoys.

In putting forward a brief summary and conclusions, Mr. Hood said that as regards the luminary for optical apparatus, authorities are generally agreed that for buoy and beacon lighting, and in many instances for secondary lights, acetylene gas, either in an open flame burner or with an incandescent mantle, is the most useful form of illuminant where electricity is unobtainable. Whether dissolved acetylene gas should be invariably used, is, however, open to question.

For large optics an incandescent mantle on a petroleum vapour burner is the most suitable illuminant unless electricity can be readily obtained at reasonable cost, when the incandescent electric filament lamp may advantageously be employed.

The need for continued development in the illumination of lighthouses has not in the least diminished, and in no circumstance must it be neglected in the endeavour to develop Hertzian or acoustic fog warnings. The greater its power the more penetrative will be the beam from the lighthouse, and the greatest will be the security afforded to the mariner by providing a signal which he may see and recognise with his eyes.

Little is said in the reports about the combination of aerial and maritime lights, and Mr. Hood is of opinion that a study of the subject should be made.

In connection with acoustical fog signals, authorities generally recognise the superiority of the siren or diaphone over other types.

Position finding by wireless is destined to be one of the most important navigational aids of the future, whether employed alone or in conjunction with sound to obtain synchronous signals.

Various countries have different direction finding systems of their own; nevertheless the problem of the most effective type should be investigated not by each country individually, but by common international agreement, and it appears to Mr. Hood that a system applicable to stations both ashore and afloat, which employs a wireless beam whose direction is ascertained by the navigator himself, should be the subject of investigation and development.

In connection with the proposed standardisation of sea-marks, all that can be stated is that the ideal has not yet been reached. Mr. Hood suggested that the following were the points requiring discussion:—(1) The uses of reinforced concrete in the construction of lighthouse towers; (2) modern ideas on the proper length of the flashes of lights exhibited from lighthouses; (3) a uniform method of the calculation of lighthouse intensities; (4) the establishment of combined aerial and maritime lights on the coast; (5) modern lighting equipment for light-vessels; (6) the advantages and disadvantages of dissolved acetylene gas and acetylene gas generated *in situ*; (7) primary fog signals and compressing plant; (8) unwatched fog signals ashore and afloat; (9) the establishment of an International Commission to investigate and consider the most suitable radio direction finding system with the consideration of the most suitable wave length, and (10) the reconsideration of the international adoption of a uniform system of buoyage and day marking.

Captain C. L. Hussey (U.S.A.) said that perhaps the Congress would consider the international adoption of some system of under-water signals by which vessels in an area of reduced visibility could give out information relative to their course and in return receive information as to the courses of other vessels in the vicinity and obtain bearings of such vessels. The development of under-water sound signalling apparatus had reached such a stage that one was justified in proposing that steps should be initiated to incorporate in the International Rules of the Road a system of sound signalling that would make that means of communication available for preventing collision during fog or periods of reduced visibility. The radio compass and position finders enabled ships to approach the coast in thick weather. It remained to supplement those aids to navigation by any means that could be provided to ensure the safety of vessels coasting and entering port. Various means for transmitting and receiving under-water sound signals were now available, and while but comparatively few vessels had been fitted with transmitting apparatus, several thousand were fitted with receiving devices. It was thought that were rules for the use of such apparatus to avoid collision formulated and incorporated in the Rules of the Road, the advantages of the system would be so apparent as greatly to accelerate its introduction into general use even if the use of the apparatus were not made mandatory by law. If there were an international code adopted for the purpose, a ship fully equipped with submarine sound signalling apparatus could periodically send out her course, and at the same time determine the course and bearing of a vessel similarly equipped. In presenting this matter for the consideration of the Congress, Captain Hussey remarked that personal experience in command of a naval vessel on patrol duty for many weeks off Nantucket had convinced him of the utility of the under-water submarine signalling apparatus.

Sir Acton Blake (Trinity House) said that a number of valuable reports had been presented and the time available for discussion was far too short. One question in which he was particularly interested was the colour of buoys. Many attempts had been made to secure uniformity. The campaign was commenced at Washington and had been continued, but he was quite certain that conditions in various countries were so different that a measure of latitude must be left to local authorities, and that only main principles could be the subject of international agreement. The important question of the marking of wrecks came up, and Trinity House, in conference with all authorities in Great Britain interested, reached the decision which was embodied in regulations being issued that day, in which it was laid down that the use of the colour green would be reserved for the starboard light and the marking of wrecks. That was an entirely new departure in the method of marking wrecks.

Director-General Hägg (Sweden) dealt with the question of uniformity of colour, particularly for beacons and buoys. The Baltic contained very complicated channels, and a very elaborate system of buoying was necessary. He was not prepared to go into the question in detail, but would confine himself to the statement that, while those who dealt with these questions in Sweden were most anxious to facilitate international regulations as to the colour of beacons and buoys, this could not be done without causing grave inconvenience to local authorities.

Mr. A. E. Butterfield (Humber Conservancy) agreed that more time should be given to the consideration of the important subjects dealt with in the report. In connection with wireless direction finding, for example, very important developments were foreshadowed. He was much interested in the rules promulgated by Trinity House for the marking of wrecks.

M. E. Montarroyos (League of Nations) expressed the opinion that in the endeavour to secure uniformity of practice the Transport Section of the League of Nations could render useful aid. That section should be asked to study the question in co-operation with technical experts.

Monsieur Andre de Rouville (France) reminded the Congress of the last Maritime Conference which had the subject under consideration, and suggested that a new conference might be called to review the whole situation in the light of the most recent developments.

Rear-Admiral Reynolds (U.S.A.) agreed with the demand that the International Association should arrange at a future Congress for the subject to receive more attention. The saving of life and property was one of the most important questions in connection with ocean navigation. In the United States a large lighthouse service was under Government control.

Captain M. H. Clarke (Commissioner for Irish Lights) insisted that the subject of lights and beaconing was the most important which the Congress had been called upon to discuss. Lights, fog signals, wireless methods, and leader cables raised questions of first-rate importance. He agreed with what had been said by the representative of Sweden as to the difficulty of bringing buoying in the Baltic into any uniform system. The Baltic was the Piccadilly or Charing Cross of the sea.

Dr. Aristide Luria (Rome) agreed that a special section of any future Congress should be formed to deal with the subjects raised in the reports submitted. Full recognition should be given by an international body connected with navigation to the methods which were being evolved to increase the safety of ships at sea.

Sir Ernest Glover agreed with the suggestion that more time should be allocated to this subject at future international gatherings. The increasing attention which was being given to enhance the safety of shipping had been plainly indicated by the reports and the discussion which had followed their presentation. Whether it would be better to form a third section was a question for the organisation of the association.

THE Leeds Corporation proposes to seek parliamentary powers to enable it to exercise "proper" control and supervision over aerials.

The Energy of the Future.

IN a lecture recently delivered at Schenectady, Dr. Charles Steinmetz, the chief consulting engineer of the American General Electric Company, remarked that the problem of energy and the problem of food supply are the two great questions of the future. "The one energy source which is available to-day is," he said, "the light of the sun, in comparison with which the total energy supply of all the fuel we burn and the hydraulic energy available is nothing. While the total energy of all the coal and all the water power we have and use in a year does not amount to more than one thousand million kilowatts, the energy of the sun, which shines only upon that part of the United States which is arid and cannot be used for agriculture, is about 800,000,000,000 kilowatts, nearly a thousand times as much as all the coal and water power together.

"So there is," continued Dr. Steinmetz, "a source of energy vastly greater than anything that we are using now or that we could possibly use. There would be no scarcity if we could open up this source of energy, but we have no means of utilising this solar energy economically, because it is so widely distributed or diluted. The real problem here is one of concentrating this energy.

"There have been solar heat engines built, in which the solar heat energy has been concentrated by reflectors. These are all very ingenious devices, and if some rich men somewhere in the wilderness wants to run a little pumping station in connection with his house, he might be able to afford it; but economically, in considering the world's energy supply, it is out of the question because the installation is so enormous, compared with the amount of energy you get, that it is economically impossible.

"But that brings me to a new field—that of biological engineering. While this field is not entirely new, yet relatively little has been done in it. Men like Burbank have done wonderful things in evolving new plants. His work is real engineering, but the materials with which he works are living plants.

"When we first began to use the sugar beet in sugar production, not only was the beet very much smaller than its present average size, but it contained less than half the percentage of sugar that is contained in the sugar beet of the present time. So, in this case, biological engineering more than doubled the content.

"The energy which we use now, after all, is solar energy, because when we burn coal we are using the sunlight which was stored millions of years ago by the plants in the primeval forests during the Coal Age. When you use water power you are using solar energy which evaporated the water and was carried up into the clouds, whence it was condensed and deposited on the highlands, and now runs in the rapid river, to be collected by us and made to turn the wheels.

"How could we collect this energy and concentrate it? The only solution of the problem that I can see lies with the biological engineer. The leaves year after year collect the energy of the sunlight, absorb it through the chlorophyl and produce chemical compounds. We have all around us the collections of solar energy by plant life, but it takes a lifetime for a forest to grow and collect energy.

"Why could not the biological engineers of the future develop new forms of vegetation which would collect the sunlight at a rate hundreds of times more rapid than our present vegetation collection scheme. Perhaps the tall grasses might be the starting point from which, by a process of selection, during generation after generation, we could work toward new varieties and find new species which would grow at such a rapid rate that we could raise energy crops and so collect energy from our lands to supply our needs, especially if we can obtain high-grade energy directly without going through the transformation of heat.

"In the production of food we use two classes of compounds, the carbo-hydrates and the nitrates, the first of which are essentially heat-producing and the second life-giving. The carbo-hydrates will be taken care of by the energy crops already mentioned. Then there would remain the problem of the nitrogen supply of the world, the protein supply.

"As we get it from cereals and meats, it is a wasteful process; it is extremely extravagant. Only a very small part of the plant is protein, and it takes a whole year to grow. Then we may feed it to animals to get animal proteins, but the efficiency of the production of animal proteins is certainly very small. Considering the amount of food the animal eats during his whole life to the time when it is slaughtered, only a small part is represented by animal proteins.

"The question of feeding future populations opens a new field for the biological engineer. In the past there has never been any systematic method of producing proteins. The natural protein producers are the micro-organisms which develop most rapidly.

"We have done much in producing new plants, but where each generation takes about a year, in micro-organisms we may have a generation a day or several generations. Therefore variation with the production of new varieties and new species can be carried on when dealing with micro-organisms at a rate of a hundred times more rapid.

"So through biological engineering the production of proteins by micro-organisms does not appear to be a hopeless task, and it may be accomplished within a reasonable time. Within a century or two or even a shorter time we could supply the food demands of the world, not through the cultivation of new areas for the growing of wheat, but by producing it through micro-organisms which would be held by suitable mineral products without depending upon sunlight.

"So you see these are the two problems—the production of energy from the sunlight and the production of food by new means which are not as limited as our present means.

"It has been stated that during the economic blockade of Germany during the war considerable advance was made in producing proteins by the growth of bacilli and micro-organisms. Various products are being made in which micro-organisms play a part. The synthetic production of rubber and other similar material, it is alleged, are developed by the work of micro-organisms."

Conversazione of the Institution of Civil Engineers.

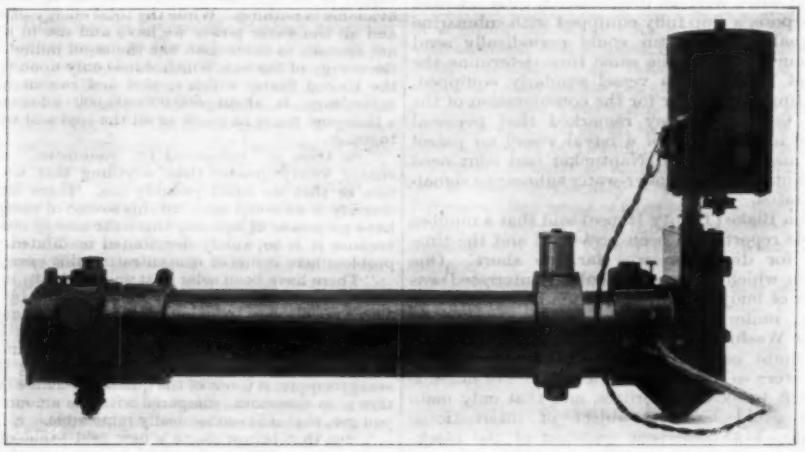
The annual conversazione of the Institution of Civil Engineers was held in the Institution building on July 12th, when the guests were received by the President, Dr. W. H. Maw, and Mrs. Maw.

In the library of the Institution there was the usual collection of engineering models and scientific apparatus, which this year included several distinct novelties.

Among them there was Dr. Hele-Shaw's stream line filter, which has now been developed on a practical scale. The filter, it will be remembered, is formed by a stack of sheets of perforated paper. The sheets are piled up so that the perforations form continuous vertical channels and are held together under considerable pressure. The stack of sheets is arranged in a tall rectangular casing. Some of the perforations are slightly larger than the others, and into the channels formed by these perforations the unfiltered liquid is introduced under a pressure, the intensity of which is dependent upon the class of liquid being treated. In the case of water the pressure ranges round about 15 lb. per square inch. The liquid escapes from the large channels through the interstices between the sheets of paper and flows away by the smaller channels. The dirt is left on the walls of the large passages—it does not appear to intrude between the sheets of paper—and is occasionally dislodged by a back flush, when it drops into a chamber at the bottom of the casing, and can be drained off. The filter exhibited contains 7000 sheets of paper of 1 square foot area each, while the pile is 2ft. 6in. high. It was shown handling some excessively muddy water, but produced a perfectly clear filtrate. The capacity was said to be 200 gallons per hour. Dr. Hele-Shaw told us that the paper sheets can be used for very long periods without it being necessary to renew or clean them, and that he had not yet found a liquid—even dyes—which could not be clarified by the filter. He is now engaged on the design of filters for dealing with the feed-water and the fuel oil of a cruiser, and pointed out that one of the great advantages of the apparatus for such purposes is the small amount of spare gear required. The flushing operation only occupies about five seconds, and thus the addition of, say, 1 per cent. to the number of units in the filtering plant will provide the necessary stand-by for cleaning.

Another very fascinating exhibit was that of Sir George Scott-Moncrieff, who demonstrated the treatment of dust by the interfacial surface tension of liquids. Sir George has found that if an emulsion is made of water, oil and bitumen, the droplets of the emulsion maintain an energetic internal movement. By applying such an emulsion to dust, the dust particles are caused to coalesce and form comparatively large masses which cannot be classed with dust in that they will quickly fall out of suspension in air. The emulsion has already been proved to be effective in allaying dust on roads, and experiments are about to be made with the idea of proving if it would be equally useful in keeping down the dust in coal mines, and thus reducing the risk of explosions.

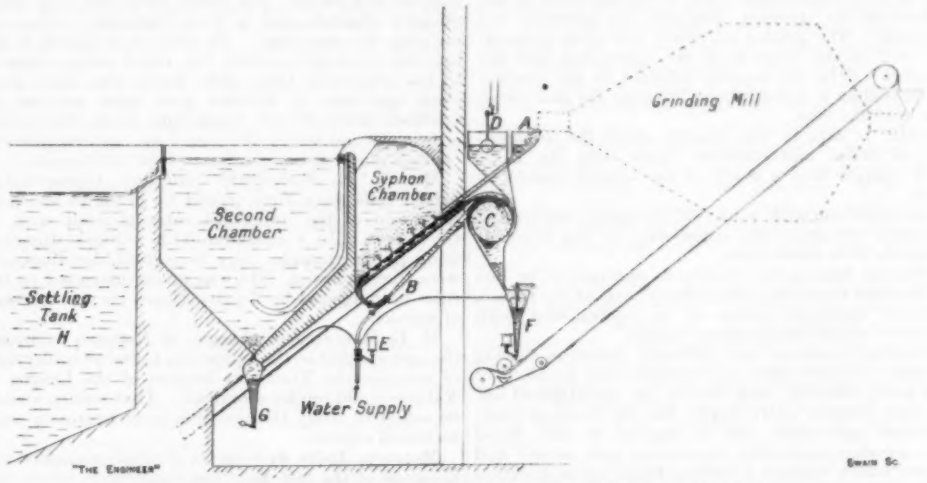
Mr. Harry J. Fereday was showing the Fereday-Palmer apparatus—which we illustrate—for recording the stresses imposed upon structures by moving loads, such, for instance, as those caused by trains passing over bridges. The instrument really measures the strain, or extension, of the material, and the stress has to be calculated according to the elastic modulus. It takes the form of a tube, about a yard long, supported on three fine-pointed legs. One of these legs is connected with a pivoted mirror, on to which a line of light is projected from a lamp within the tube. If the object on which the instrument is stood is stretched or compressed the mirror will be deflected and the line of light moved along a vertical graduated scale. The extent of this movement is obviously a measure of the strain in the member on which the instrument is placed. The instrument is calibrated by mounting it over a bar of steel, about ½in. by ¼in. in section, of which the modulus has been determined by deadweight tests. The bar is stressed to definite extents, and the scale of the instrument is then marked accordingly. Another bar is then calibrated against the instrument and is supplied with it for checking purposes. The inventor says that the recorder can be relied upon as regards accuracy within 1 cwt. per square inch of stress.



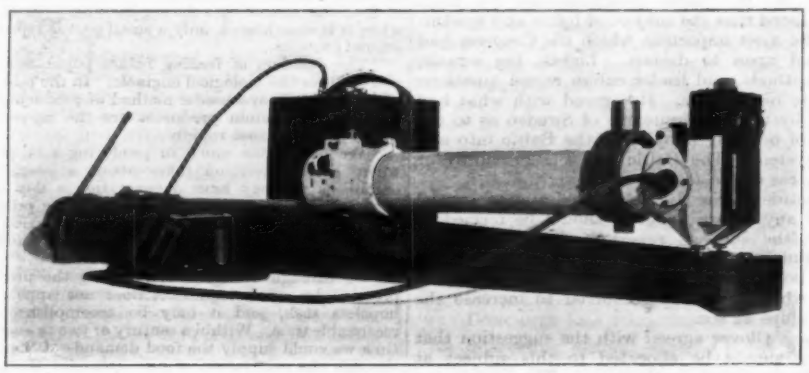
FEREDAY-PALMER STRESS INDICATOR

If it is desired to make a continuous record of the variations in stress the line of light is projected on to a moving photographic film, and Mr. Fereday has evolved a very ingenious little electric motor for driving the film. A number of electro magnets are arranged axially round the spindle of the motor, with their poles all pointing in one direction. The armature is a soft iron ring attached to the spindle by a universal joint, so that it lies at an angle with respect to the plane of the magnet poles, rather after the fashion of the swash plate of a rotary engine. The magnets are energised in succession, and attract the armature ring so that it wobbles round, rolling on the pole face. On account of the angularity of the ring, the path which it traverses is less in circumference than its own periphery, and a precessional effect is produced which drives the armature axle round at a speed determined by the relative diameters of the ring and its path. The latter dimension is obviously fixed by the degree of angularity of the armature ring. By moving the universal joint of the ring to or from the pole face this angularity may be varied from zero, when the ring is parallel with the pole face and no rotation takes place, to a maximum chiefly determined by the attractive power of the magnets. In this way a range of speeds from 10 up to 160 revolutions per minute can be secured in the case of the little motor we saw at the conversazione. A very high efficiency is maintained throughout this range, as may be judged from the fact that the motor may be run quite a long time off the dry battery of a pocket flash lamp. Another noteworthy feature about the motor is its rapid acceleration. It will run up to full speed in the one-hundredth part of a second and stop in one-fiftieth.

A model apparatus for hydraulically classifying finely ground materials, which was exhibited by Mr. Leonard Andrews, embodies several novel ideas, and gives promise of solving the problem of separating fine materials on a large commercial scale with a moderate amount of water. Mr. Andrews told us, in fact, that he has succeeded in reducing the quantity of water used from about 400 times the weight of material handled down to some 20 to 23 times. The principle of the apparatus may be followed in the diagram which we reproduce, while the effectiveness of the classification is shown in the half-tone engravings. It is intended for working in conjunction with wet grinding mills, and not only separates out the fine particles, which are the ultimately required product, but also quickly separates out the coarser grades and returns them to the mill, so that the grinding is carried on as efficiently as possible.



ANDREWS APPARATUS FOR CLASSIFYING FINELY GROUND MATERIALS



FEREDAY-PALMER STRESS INDICATOR BEING CALIBRATED

Referring to the diagram, it will be seen that the discharge from the mill is received by a hopper A and flows down an inclined plane. The lower part of this plane forms the floor of a syphon chamber, and is perforated. Through the perforations intermittent jets of water are projected, which stir up the material and drive it into the slowly rising stream of water in the syphon chamber. The fine particles are carried up through the syphon by the water, but the heavier pieces subside on to the bottom again as the jets fade away. The more massive material is progressively acted on by the jets, as it gravitates towards the bottom, and in the process a large part of the fines, which may be adhering to the coarser particles, are dislodged and floated away. The coarse material finally arrives at the bottom and finds its way into the ejector B, which is intermittently supplied with high-pressure water. (The mechanism for controlling this supply is described later.) The pressure naturally varies with the circumstances, but in the case of the model at the conversazione was furnished by a tank in the gallery of the library, which provided a head of some 18ft. The ejector drives the material up a pipe and delivers

it tangentially into a vortex chamber C. Here the more heavy particles are separated out by centrifugal action, and drop into the hopper below, while the lighter stuff goes away at the top with the water that provides the jets in the bottom of the syphon chamber.

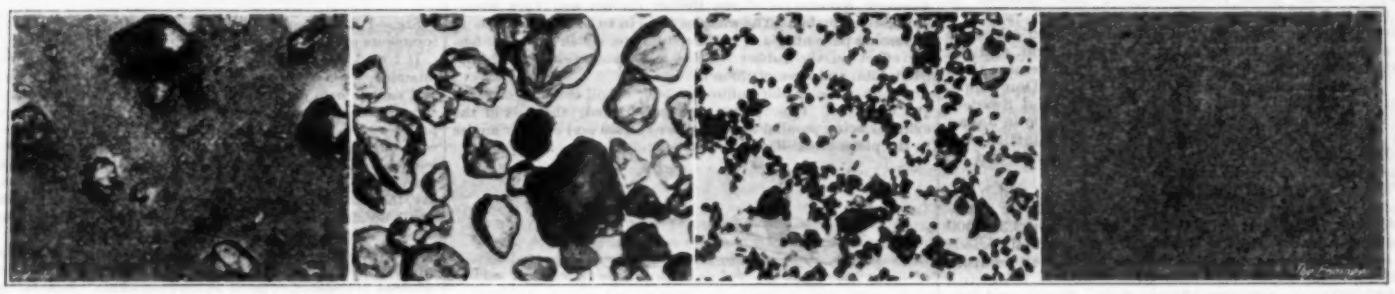
The rate at which water is supplied to the system by the ejector jet is arranged slightly in excess of the steady flow through the syphon, so that there is a tendency for the water level to rise. In a special compartment there is a float D which operates an electrical switch that supplies current to the solenoid E of the high-pressure water supply valve. In this way, it will be seen, the intermittent jets already referred to are obtained. It will be noticed that just above the water valve there are two small branch pipes, one of which leads to the bottom of the hopper below the vortex chamber. A small stream of water is sent up this pipe at the same time as the ejector is in action, and by rising through the hopper prevents the downward passage of any solid material. A somewhat similar arrangement, it will be seen, is provided at the bottom of the first settling tank following the syphon chamber. The coarse stuff from the vortex chamber drops down into a secondary hopper F when the ejector is out of action, and is discharged through an electrically-operated gate on to an elevator belt. On this belt it is drained of surplus water and is returned to the inlet of the grinding mill.

Although the syphon-chamber effects a good classification of the material, it is inevitable that a small proportion of medium-sized particles will pass over with the fines, but these are finally separated out in the second chamber, through which there is an extremely slow flow of water, and are caught in the pocket G. The water escapes from the second chamber over a weir, and carries with it into the final settling tank H only fine material.

Mr. Andrews told us that he has successfully classified some of the finest materials, such as pigments having particles 0.005 mm. in diameter, while fuller's earth and silver sand could be separated—as shown in the half-tone engravings—which represent the material as delivered at the hopper A, the coarse collected at the hopper F, the middlings from the pocket G, and the fines from the settling tank H.

Professor Coker had a very fine apparatus for exploring the stresses in structures by means of polarised light in the manner which is familiar to our readers. It had an illuminated field a yard long by about 10in. deep, in which there was arranged a model of a two-pin arch bridge with plate girder approach spans. Arrangements were provided for loading the bridge so as to represent, more or less, a rolling load, and the stresses produced in the members were vividly shown up by the changes in the colour of the transmitted light. The stresses were, of course, those produced by the applied load, and we asked Professor Coker if he saw any possibility of simulating the stresses caused by the dead load of the bridge itself, if it were made of steel; but he said that he could not imagine a material which would be transparent and yet sufficiently heavy.

There were a great number of other exhibits, over and above those we have mentioned, but it was impossible in the time available and in the torrid atmosphere of the library, to investigate them all. Among them there were an elaborate machine for measuring the teeth of gear wheels, from the National Physical Laboratory, shown by Mr. G. A. Tomlinson; Mr. John C. Fergusson's percentage compass and range finder; a "super-micrometer" for measuring in ten-thousandths of an inch, but suitable for ordinary tool room service, made in America and exhibited by Buck and Hickman; some levitating magnets made of Japanese cobalt-chrome steel, shown by Mr. F. Harrison Glew; an improved engineers' level, by Messrs. Cooke, Troughton and Simms, of which the essential parts were described in our patents columns on July 13th; some strain viewers, for examining glass ware with the aid of polarised light, shown by Adam Hilger, Limited; and a Kent steam meter, exhibited by Mr. J. L. Hodgson. The Western Electric Company also had an elaborate stand on which there were displayed apparatus for traffic control, the cathode ray oscillograph which we have already described, and some fine crystals of Rochelle salt used to demonstrate piezo-electric phenomena.



As Fed In. *From Hopper F.* *From Pocket G.* *From Settling Tank.*

MICROGRAPHS SHOWING CLASSIFICATION OF FINELY GROUND MATERIALS

Lloyd's Register of Shipping.

THE new edition of Lloyd's Register Book contains as usual very complete particulars of all the sea-going vessels of the world, of 100 tons and upwards, and, in addition, of the steel and iron vessels trading on the Great Lakes of North America. It thus includes a full record of upwards of 33,500 steamers, motor vessels and sailing vessels. The volumes comprise also many lists of great practical value to the shipping community, such as:—Signal letters assigned to all sea-going vessels; shipbuilders and marine engineers in all countries; telegraphic and postal addresses of firms connected with shipping in all parts of the world; particulars of dry and wet docks, ports, harbours, &c., at home and abroad; particulars of speeds of merchant steamers capable of 12 knots; particulars of deadweight and cubic capacities of cargo steamers and motor vessels; lists of bulk oil carriers; lists of shipowners and managers, with the names and tonnages of their respective vessels, &c.

The section of the book which is perhaps of the greatest interest to the general public is that containing the statistical tables. The contents of these tables will repay careful study, and the following summary of some of the results which are to be obtained by an analysis of them, and by a comparison with similar tables issued by Lloyd's Register in previous years, will be found of interest.

CLASSIFICATION OF VESSELS.

We may, perhaps, before dealing with the other statistical tables, draw attention to the figures given in Table No. 4 respecting the number and tonnage of vessels classed by Lloyd's Register of Shipping. The new edition of the Register Book contains particulars of 33,507 vessels of 100 tons each and upwards, with a total tonnage of 65,166,238 tons, and the number and tonnage of existing vessels which are now or have been classed by the Society is 15,875 of 38,861,967 tons. Practically all these vessels were built under the inspection of the surveyors of Lloyd's Register.

Comparison of Gross Tonnage owned at June, 1922, and June, 1923.

	Where owned. Great Britain and Ireland.	Other countries.	Total.
1922—			
Steamers and motor vessels	19,088,638	42,254,314	61,342,952
Sailing vessels	206,999	2,820,835	3,027,834
Total	19,295,637	45,075,149	64,370,786
1923—			
Steamers and motor vessels	19,115,178	43,220,195	62,335,373
Sailing vessels	166,371	2,664,494	2,830,865
Total	19,281,549	45,884,689	65,166,238

The above table shows that during the last twelve months there has been an increase in the steam tonnage owned in the world of 992,421 tons, and a decrease in the sailing tonnage of 196,969 tons, making a net world increase of 795,452 tons. The countries with the largest increases are Germany, with 702,665 tons; and Italy, 167,407 tons. On the other hand, the largest decreases have occurred in the United States sea-going tonnage (141,471 tons) and in France (108,548 tons).

TONNAGE OF STEAMERS AND MOTOR VESSELS.

Although there are still nearly two million tons of wood and composite steamers in existence, in view of the comparatively small importance in international trade of such tonnage, it would perhaps be more accurate, for the purpose of comparison between the relative positions of the various merchant marines, if only steel and iron sea-going vessels were taken into account.

Sea-going Steel and Iron Steamers and Motor Vessels Owned by the Principal Maritime Countries.

Country.	June, 1914. Tons gross.	June, 1923. Tons gross.	Difference between 1923 and 1914. Tons gross.
Great Britain and Ireland	18,877,000	19,077,000	+ 200,000
British Dominions	1,407,000	2,219,000	+ 812,000
America (United States)	1,837,000	12,416,000	+ 10,579,000
Austria-Hungary	1,052,000	nil	—
Belgium	341,000	600,000	+ 259,000
Denmark	768,000	920,000	+ 152,000
France	1,918,000	3,265,000	+ 1,347,000
Germany	5,098,000	2,496,000	— 2,602,000
Greece	820,000	743,000	— 77,000
Holland	1,471,000	2,606,000	+ 1,135,000
Italy	1,428,000	2,788,000	+ 1,360,000
Japan	1,642,000	3,402,000	+ 1,760,000
Norway	1,923,000	2,299,000	+ 376,000
Spain	883,000	1,169,000	+ 286,000
Sweden	992,000	1,092,000	+ 100,000
Other countries	2,057,000	2,847,000	+ 790,000
Total abroad	23,637,000	38,862,000	+ 15,225,000
World's total	42,514,000	57,939,000	+ 15,425,000

It will be seen that amongst the principal countries apart from Germany, Greece is the only one which still shows a reduction in the tonnage now owned as compared with 1914. The sea-going tonnage of the United States has increased by over 10½ million tons. The other countries in which the largest increases are recorded are:—Japan, 1,760,000 tons; Italy, 1,360,000 tons; France, 1,347,000 tons; and Holland, 1,135,000 tons. Taken together, the Scandinavian countries—Norway, Sweden, and Denmark—show an increase as compared with 1914 of 628,000 tons. In 1914 the United Kingdom owned nearly 44½ per cent. of the world's sea-going steel and iron steam tonnage; the present percentage is just under 33. The United States occupy now second place with 12,416,000 tons—equal to 21.4 per cent. The other leading countries are:—Japan, 3,402,000 tons; France, 3,265,000 tons; Italy, 2,788,000 tons; and Holland, 2,606,000 tons. Notwithstanding recent increases in the tonnage owned in Germany, the above table shows the change which has taken place in the maritime position of that country, where the tonnage now owned is some 2,602,000 tons less than in 1914. Obviously the above figures do not take into consideration the question of the efficiency of the various merchant navies, as in addition to such factors as size, age, type, and speed of the vessels, other circumstances, which do not lend themselves to a statistical analysis, would have to be taken into account.

AGE AND SIZE OF STEAMERS AND MOTOR VESSELS.

A considerable increase has taken place in recent years in the number of sea-going steam and motor vessels of 4000 tons each and above. In 1914 there were 3608 such vessels, and now the number reaches 5636, of which 350 are of 10,000 tons each and upwards, including 33 of 20,000 tons each and upwards. Of the 350 vessels 196 are under the British flag. It may be noted that one half of the total number of vessels in existence consists of those of less than 1000 tons each.

In Table No. 3, in which all existing vessels are classified according to their size and age, it is shown that there are 6913 vessels less than five years old and that their tonnage represents 35 per cent. of the total tonnage in existence. Vessels of twenty-five years and over amount to 6551, but their tonnage is less than 12 per cent. of the total. Of the vessels built prior to 1899 64 per cent. are of less than 1000 tons each and the average size of the others is 2543 tons, while of the vessels built during the last five years only 33 per cent. are of less than 1000 tons each and the average of the others reaches 4557 tons. Of the 791 vessels, each of 8000 tons and upwards now in existence, 338 have been built during the last five years. Of the tonnage owned in Great Britain and Ireland 29.1 per cent. is less than five years old. The merchant navies, which have the largest proportion of new tonnage—less than five years old—are as follows:—United States (sea), 57.3 per cent.; Germany, 52.6 per cent.; Holland, 37.8 per cent.; Canada, 36.8 per cent.; Japan, 35.3 per cent.; and France, 34.7 per cent. The group of vessels which form the largest tonnage is that of between 4000 and 6000 tons each amounting to 17,421,255 tons, equal to 28 per cent. of the world's total tonnage, while the big liners, say those of 15,000 tons each and upwards, only represent about one thirty-fifth part of the total tonnage in existence.

TYPE OF VESSELS AND OF MACHINERY.

Two very interesting new tables have been added to the Register this year which show:—(1) The type of machinery used for the propulsion of vessels; (2) particulars of the oil tankers, of the trawlers and other fishing vessels, and of the steamers fitted for burning oil fuel.

The following summary will not be without interest:—

The first table shows the great development which has taken place in the use of steam turbine engines and of internal combustion engines. There are now 1386 steamers of 8,893,749 tons fitted with turbine engines and 1795 vessels—including auxiliary vessels—of 1,666,385 tons, fitted with internal combustion engines as compared with 730,000 tons and 220,000 tons respectively in 1914. Of the 917 tankers—of 1000 tons and upwards—with a total tonnage of 5,160,973 tons, 312 of 1,691,257 tons are registered in Great Britain and Ireland and 399 of 2,497,625 tons are registered in the United States. Of the 3049 steamers fitted for burning oil fuel 601 of 3,792,676 tons are registered in Great Britain and Ireland and 1709 of 8,798,776 tons are registered in the United States of America.

The figures in these two tables enable a comparison to be made between the respective need of coal and oil fuel at the present time as compared with 1914:—

	1914. % of total gross tonnage.	1923. % of total gross tonnage.
Sail power only	8.06	4.34
Oil, &c., in internal combustion engines	0.45	2.56
Oil fuel for boilers	2.65	24.23
Coal	88.84	68.87
	100.00	100.00

It will thus be seen that less than 69 per cent. of the tonnage of the merchant marine now depends entirely upon coal, while in 1914 the percentage was nearly 89.

SAILING TONNAGE.

The reduction in sailing tonnage since pre-war times, say June, 1914, amounts to about 1,150,000 tons. The present percentage of sailing vessels to the world's total tonnage is less than 4½. Of the world's sailing tonnage 1,260,000 tons—equal to 44½ per cent. of the total tonnage—are now owned in the United States, and the other countries which still have a considerable amount of sailing tonnage are :—France, 284,000 tons; Norway, 176,000 tons; Great Britain and Ireland, 166,000 tons; and Italy, 153,000 tons.

TONNAGE OWNED IN THE WORLD AT VARIOUS DATES.

Another new table which will be of great use for the purpose of ascertaining the development of the merchant navies during the last thirty years or so is Table No. 8, which shows for each of the years 1890–1923 the number and the gross tonnage of the steamers and of the sailing vessels owned in the world, distinguishing also the principal maritime countries. In this table some remarkable increases can be observed. In 1890 the gross tonnage of steamers amounted to 13 million tons, and the net tonnage of sailing vessels to over 9 million tons. The steamers have increased by over 49½ million tons while the sailing tonnage has decreased by over 7 million tons gross. Apart from the remarkable increase which has taken place in the United States sea-going tonnage—over 12¾ million tons—and the recent decrease in the German tonnage, both due to the war, the following are the most noticeable changes during this period of thirty-three years :—The sail tonnage registered in Great Britain and Ireland and in Norway, which in 1890 amounted to about 2,664,000 tons gross and 1,444,000 tons gross respectively, is now reduced to 166,000 and 176,000 tons respectively.

Over 11½ million tons of steamers have been added to the shipping owned in Great Britain and Ireland, and the steam tonnage of the following countries is now more than five times as large as it was in 1890 :—British Dominions, Denmark, Holland, Italy, Japan, Norway, and Sweden. The most remarkable increases have taken place in Japan and Holland, the steam tonnage of which countries now reaches a figure equal respectively to 26 times and 12 times the total owned in 1890.

The twelve months prior to the war, during which the greatest increase took place in the merchant navies of the world, was from June, 1912, to June, 1913, when 2,370,000 tons were added. During the last three decennial periods the world increases have amounted to 9,265,000 tons from 1893 to 1903, 13,468,000 tons from 1903 to 1913, and 17, 885,000 tons gross from 1913 to date. It is remarkable to note that notwithstanding the varying conditions met during a period of thirty years—including the late war—the percentage of increase for these periods does not differ to any extent, namely, 38.2 per cent., 40.2 per cent., and 37.8 per cent. respectively.

The following is a summary of the statistical tables issued in the appendix of the 1923 edition of the Register Book :—Table No. 1 shows the number, gross tonnage, description and material of the vessels of 100 tons and upwards, belonging to each of the several countries of the world. Table No. 2 illustrates the demand of each country for certain sizes and vessels. The table classifies the steamers and motor vessels owned in the world, distinguishing the principal maritime countries, according to certain divisions of gross tonnage. Table No. 3, a new table, shows the number and tonnage of steamers and motor vessels according to certain divisions of tonnage and of age. Table No. 4 shows the number and tonnage of all vessels in existence which are or were formerly classed with Lloyd's Register. Table No. 5 shows the number of vessels according to certain divisions of tonnage and the total tonnage classed by different classification societies. Table No. 6, a new table, shows the type of machinery used for the propulsion of vessels, dividing the vessels according to whether they are steamers with reciprocating engines or turbine engines; or motor vessels; or sailing vessels fitted with auxiliary steam or motor power. Table No. 7, a new table, shows the number and tonnage of oil tankers, of trawlers and other fishing vessels, and of steamers fitted for burning oil fuel. Table No. 8, a new table, shows for each one of the years 1890 to 1923 the number and gross tonnage of the vessels owned in the world distinguishing the principal maritime countries. Tables Nos. 9, 10 and 12 are extracted from the annual shipbuilding returns issued by the Society. They show the total number and tonnage of vessels launched by the various countries of the world each year from 1892 onwards; and the number of vessels according to certain divisions of gross tonnage launched yearly during that period in Great Britain and Ireland, and also abroad during the years 1918–1922. Table No. 11 shows the number and tonnage of steamers and motor vessels lost throughout the world owing to marine and war casualties during the last twenty-one years, distinguishing the losses of the principal maritime countries. Cases of vessels broken up, dismantled, &c., not due to stress of weather, are excluded. A most interesting point of this table is that it gives for each country the percentage lost of the total tonnage owned. Table No. 13 shows the number and gross tonnage of new vessels classed by Lloyd's Register during the calendar year 1922. Notwithstanding the general depression in the shipbuilding industry the tonnage of these vessels reached the high total of 1,964,602 tons.

HAVING occasion again to refer to Colonel Mount's report on the buffer-stop collision at Pollokshaws on January 17th last, we notice a point therein which escaped our attention when we mentioned the report in our issue of May 18th. The destruction of the signal-box, consequent on the collision, disarranged the signals and the driver of the night express from St. Pancras to Glasgow noticed that, although the home signal was in his favour, the distant signal indication did not agree. Suspecting something was wrong, he shut off steam and applied the vacuum brake, and although running at 60 miles per hour pulled up in a distance which we estimate from information in the report to have been from 800 to 900 yards.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE HERBERT PENDULUM HARDNESS TESTER.

SIR,—Will you allow me to compliment your correspondent Mr. S. Timoshenko, on his very valuable contribution to the mathematical theory of the pendulum hardness tester. The remarkable agreement between the periods of oscillation experimentally observed and those calculated by means of Mr. Timoshenko's formula seems to give confirmation of his theory so far as he has applied it to the two cases of a perfectly rigid plane surface, and one in which permanent indentation takes place. When, however, he states that "the same result [as on a rigid surface] may be expected also in the case of a perfectly elastic plane surface," *i.e.*, that the period of swing is inversely proportional to the square root of the length of the pendulum, and therefore independent of the hardness of the surface, I think he is wrong both in theory and in fact.

When the pendulum is used to test the hardest steels, such as steel balls, whose hardness it gives as 80 to 85—equivalent to 800 to 850 Brinell—and on many substances of still greater hardness, there is reason to believe that the deformation produced by the ball is purely elastic, since no permanent indentation can be detected, but the time of swing is by no means constant for a given length of pendulum. Subject to an exception to be noted later, it increases regularly with the hardness of the specimen.

With a view to inducing Mr. Timoshenko or some other mathematical reader of THE ENGINEER to develop the theory still further, will you permit me to give some test results obtained with the pendulum on a highly elastic substance, rubber?

Eight samples of soft rubber were kindly supplied by the Research Association of the British Rubber and Tyre Manufacturers, Croydon. The samples were in two series, containing increasing percentages of barium sulphate, which has a hardening effect on the rubber. Tests were made with the 2-kilo. pendulum, and were of three kinds.

A: In place of the millimetre ball, a half-cylinder of steel, ⅛in. diameter, 1⅛in. long, was substituted, the axis of the cylinder being parallel to the rubber surface and at right angles to the plane of oscillation of the pendulum—Fig. 1.

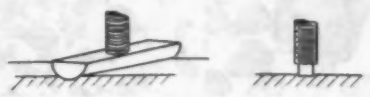


FIG. 1—TEST A.

FIG. 2—TESTS A & B.

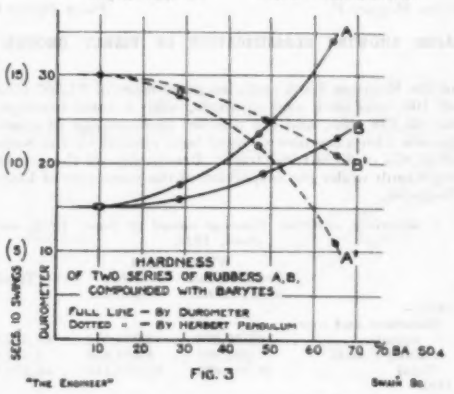


FIG. 3

B: The flat end of a vertical steel cylinder, ⅛in. diameter, was used instead of the ball—Fig. 2.

C: A similar flat-ended cylinder, ⅛in. diameter, was used.

The time for ten swings of the pendulum was taken in each case, and the specimens were then tested by the Research Association with the standard durometer or indentation needle. The hardness figures were as follows :—

Sulphate, per cent.	Seconds for ten swings. A.	B.	C.	Durometer.
1st Series—				
10	30	8	15	15
29	27.5	7	13.8	17.5
47	19	5.4	11	23.3
64.5	10	2.8	5.4	33.8
2nd Series—				
10	30	8	15	15.2
29	27	7.5	14	15.8
49	27.5	6.6	12.5	18.8
65.5	20	5.4	10.5	23.0

Fig. 3 is a graph kindly prepared by the Rubber Research Association, showing the results of tests C and the durometer readings.

From these results the following conclusions can be drawn :—

(1) The pendulum time test measures the hardness of such a perfectly elastic substance as rubber, and measures the same kind of hardness as the indentation needle, *i.e.*, elastic indentation hardness.

(2) The time of swing on rubber diminishes as the hardness increases, which is the reverse of what happens when testing with the 1 mm. ball on metals.

(3) The effect of increasing the area of contact between the flat test member and the rubber is to lessen the time of swing, the times with the ⅛in. cylinder B being about half those with the ⅛in. cylinder C.

As a corollary from conclusion (2), it appears that the elastic hardness of the rubber produces a restoring moment of force, which is superimposed on that due to gravitation, the harder rubber effecting a greater acceleration and therefore a more rapid swing.

As a corollary from conclusion (3), it is evident that the restoring moment due to elastic hardness increases with the diameter of the surface of contact.

Applying these principles to the case of the ball indenting a hard elastic substance, such as very hard steel, it is evident that the elastic hardness should tend to quicken the motion of the pendulum in accordance with the first corollary, and to slow its motion in accordance with the second corollary, since the hardness, in resisting indentation, tends to lessen the area of contact.

It further appears that these two opposing tendencies are not generally equal, the slowing tendency being more important when the ball is used to test hard elastic substances, and the quickening tendency being more effective when a cylindrical surface is used to test soft elastic substances.

One further fact, hitherto unpublished, should be mentioned in this connection. A pendulum time test on a sapphire plate, using a millimetre ball of either steel or ruby, gives the sapphire a considerably lower hardness number than that of glass. If the pendulum is set to 100 on sapphire, the hardness of plate glass is 115.

The explanation of this rather startling fact is believed to be as follows. When a weighted ball rests on a surface as rigid as that of sapphire, some deformation must take place, otherwise there would be point contact and infinite pressure, and this deformation takes place chiefly in the ball. The local elastic deformation of the ball increases its radius of curvature, raises its centre of curvature, increases the distance between the centre of curvature and the centre of gravity, thus lengthening the pendulum and lessening its time of oscillation.

Although this explanation seems plausible, the fact that there is an apparent reversal of the law of motion of the pendulum on highly elastic substances at both ends of the scale of hardness, on sapphire and on rubber, makes one diffident about offering explanations, and my present purpose will have been accomplished if I have succeeded in giving the mathematicians some food for thought.

EDWARD G. HERBERT.

West Didsbury, Manchester, July 13th.

RAILWAY SPEEDS.

SIR,—I have been prevented hitherto from replying to your comments of July 6th on my previous letter.

If I read into your leading article of June 8th what was not intended, I gladly apologise. On reading that article again, I still cannot help feeling that its concluding portion constitutes a deprecation, not merely of higher maxima, but of increased journey speeds, and therefore of reduced end-to-end times. It was your apparent opposition to the latter that seemed deplorably reactionary. Your position is that five or ten minutes on a long journey are not worth saving; but the big savings in time in, say, the last forty years, have mostly been made up of successive small accelerations, and the proverb about "little drops of water" seems to apply!

The process of reading into words more than they contain must be infectious, for you, in turn, discover in my letter a criterion of locomotive merit which I repudiate. A mere "flier" which cannot pull is not my ideal engine, nor, I imagine, anyone else's. But our present express engines are "fliers" which can and do pull, and my contention is that if their capacity to "fly" were as readily recognised as their power to "pull," almost all existing bookings could be materially reduced. All our big locomotives can run as fast as any of their predecessors, and occasionally they prove it, when called upon, either by emergencies or a driver's whim; but they do not need to show these powers merely to maintain the current schedules. I greatly doubt whether any express of to-day need ever exceed 75 miles per hour under its maximum loading, provided a clear road is kept and the engine is pushed reasonably hard uphill. The reserve of speed is there. What valid argument is there against its utilisation?

I am not specially impressed by the punctual arrivals to which you allude. They are no doubt praiseworthy; but unless the trains in question had encountered delays or exceptionally bad weather, it is virtually a certainty that the drivers had "eased" their engines—possibly for quite long distances—to avert too early an arrival. This is the experience of all who habitually "clock" express trains. It knocks the bottom out of the plea that any acceleration must call for bigger locomotives or much heavier maintenance.

HORACE MYERS, Major.

London, N.W. 8, July 17th.

GAS-DRIVEN ALTERNATORS FOR SOUTH AFRICA.

SIR,—In your issue of July 13th, in the article dealing with the above subject, you mention that the decision to employ gas-driven alternators to operate with Rhodesian coal was arrived at after personal inspection of gas engines and gas plants throughout the Colony, and, in particular, gas plants at Rooiberg and Nieuport, at both of which places you state gas plants of the double draught type were giving satisfactory service with local bituminous coal.

One would infer from your description that the gas plants which gave satisfactory service at Rooiberg and Nieuport were of the same construction and design as those mentioned in your article. We write to point out that the gas plants and engines at both of the places mentioned were manufactured and supplied and erected by ourselves.

We shall be glad if you will insert this letter in your next issue, as we think it should be known that we are the makers of the plants in question.

THE CAMPBELL GAS ENGINE CO., LTD.,
HUGH CAMPBELL, Director.

Halifax, July 18th.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first five months of the present year was as follows, the corresponding figures for 1922 and 1921 being added in parenthesis :—Locomotives, £1,362,326 (£2,841,317, £3,109,568); rails, £986,318 (£1,418,337, £1,765,102); carriages, £544,971 (£817,573, £668,093); wagons, £1,369,622 (£1,926,718, £2,682,351); wheels and axles, £451,854 (£706,396, £980,950); tires and axles, £208,851 (£229,110, £696,948); chairs and metal sleepers, £366,825 (£1,089,147, £714,264); miscellaneous permanent way, £471,086 (£745,802, £1,319,464); total permanent way, £2,609,931 (£4,288,251, £5,613,725). The weight of the rails exported was 110,251 tons (136,404 tons, 80,146 tons) and of the chairs and metal sleepers, 33,562 tons (79,752 tons, 29,008 tons). During May, locomotives to the value of £153,689 were shipped to India, and rails to the value of £38,951 to India and of £26,085 to Australia.

Railway Matters.

It is significant that the London, Midland and Scottish Company announces that its train from St. Pancras to Harrogate has "dining car seats free of charge." This is a reply to the supplementary fares charged on the Pullman express of the London and North-Eastern.

THE Northern of France is withdrawing from the Calais-Dover service its two paddle steamers, the Nord and the Pas de Calais. It has purchased from the Southern Railway the turbine steamers Empress and Invicta. Many travellers will regret the change. The paddle vessels were slow, it is true, but were good sea boats.

THE retirement, after nearly fifty years' service with the London and North-Western Railway, is announced of Mr. J. H. Thurstan, who, for twenty-eight years, has been the engineer-in-charge of the Lancaster and Carlisle district, which covers the main line between Wigan and Carlisle and the branches in the West Cumberland area.

THE London correspondent of the *Manchester Guardian*, recently, was shown the trouble wholesale milk contractors in the country go to in order to cool the milk before it leaves their factories. It is then, however, put into railway vans that have a temperature of 88 deg. or 90 deg. This leads us to suggest that the companies might use properly insulated vans, similar to those employed in the carriage of meat, bananas, &c., for the conveyance of milk. It is a traffic that barely pays, and so the methods of handling and transit are somewhat rough-and-ready.

A CORRESPONDENT, writing to *The Times* recently, complained that he had to pay 1s. 2d. for the carriage of his suit case from Euston to South Hampstead, whereas he could have made the journey himself, together with the suit case, for 3d. Those who make complaints of this sort overlook the amount of labour the conveyance of a suit case, or any other consignment, entails. It has to be taken to the train, lifted into the van, taken out at its destination and conveyed to the cloak room. Moreover, there are clerical services at each end. A passenger entails no such labour.

ANSWERING a question recently on the subject of the periods for which season tickets were issued, Lieut.-Colonel Ashley said that the Railway Rates Tribunal had recently had under consideration the form of Schedule of Standard Charges for Season Tickets when the question of an allowance to be made in the case of sickness or holidays was raised. The Tribunal had requested the railway companies to publish so soon as possible the general conditions under which season tickets would be issued in order that they might be taken into consideration when the fixing of the charge to be paid by the public was determined.

AN article in the *Manchester Guardian* of Wednesday last reported that the London, Midland and Scottish Railway Company was contemplating the conversion to electric traction of the main line between Preston and Carlisle. That this may be so is, we consider, quite likely. There are few stretches of main line in this country more suitable for electric traction. The distance between the points named is 91 miles, and includes, on the down line, the Oxenholme bank from Milnthorpe to Grayrigg, 13 miles, of 1 in 104 to 1 in 173, and the Tebay bank, from Tebay to Shap Summit, 5 miles, of 1 in 75. On the up road there is the continuous climb, averaging about 1 in 130, from Carlisle to Shap Summit, 32 miles.

ONE of the powers secured by the Ministry of Transport in 1919 was that of making Orders compelling railway companies to carry out works. This was done under paragraph (*d*) of Sub-section (1) of Sec. 3 of the Ministry of Transport Act. By Sec. 16 of the Railways Act, 1921, these were continued except that the works so ordered were not to cost more than £100,000. This has proved very convenient to the railway companies, as it has rendered unnecessary the obtaining of a special Act for new works. The limit has been found, though, to be too low, and the Railways (Authorisation of Works) Bill, read a second time in the Commons on the 6th inst., seeks to increase the limit to £500,000. This has furnished an objection in some quarters that the opportunities for criticising the railway companies will be removed. The Bill was eventually read a second time by 156 votes to 73. Judging by the speeches made on the occasion it would appear that many members are unaware of the powers given to the Railway Rates Tribunal, which cannot, however, be of full effect until the standard charges have been submitted under Sec. 30 of the Act of 1921, and the Tribunal has approved them, and, under Sec. 31, fixed the appointed day when they will be brought into use. The preparation of these charges has been a great task, but it is expected to be finished by the end of this month.

AFTER several verbal and written exchanges of views between the railway companies' representatives and those of the men's unions as to the modification in working conditions sought by the former both parties formally met on Tuesday last. The companies seek for a reduction in the concessions made, they say, at the dictate of the Government in the National Agreement of March 27th, 1919, which was the sequel to the promise made when the eight hours' day was agreed to by Sir Albert Stanley, the then President of the Board of Trade, in December, 1918, that a committee should be set up to consider the conditions of service. The Scottish companies succeeded in January, 1922, in getting the eight hours' day modified, and in the following March the English and Welsh companies won the consent of the unions to a like course being followed on their lines. The companies have for some months been seeking for the concessions to be modified. The men reply that the financial condition of the companies does not warrant modification, the Associated Society of Locomotive Engineers and Firemen going further and saying that wages should be raised. It is desirable to add that there is no question of altering the minimum wage agreed to in January, 1920, nor of disturbing the basic day of eight hours. The delegates not being able to agree on Tuesday last, the matter will go to the Central Wages Board and thence, it is expected, to the National Wages Board. On the latter are representatives of the public.

Notes and Memoranda.

THE value of the output of metalliferous ores in the Province of Ontario for the first three months of 1923 is placed at 9,241,000 dollars, an increase of 2,014,000 dollars, as compared with the same period in 1922. Northern Ontario's nickel mines contributed substantially to this increase, their production being nearly a million dollars.

IN a recent report on mining operations in the Province of Quebec, issued by the Minister of Mines, Colonisation and Fisheries, the total mineral production for 1922 is shown to be 18,335,153 dollars, an increase of 18.1 per cent. over the figures for 1921. When it is considered that Quebec is not yet a gold producing province, and that the increased yearly production in other provinces is attributable to that mineral, the showing is gratifying. The number of men employed in the mines and quarries for periods of variable lengths in 1922 was 7808, an increase of 1192 over 1921.

THE Congella graving dock, which is being built at Durban, and will, according to the *S. A. Mining and Engineering Journal*, be completed next year, is claimed to be the second largest of its kind in the world. The total length of the dock is 1232ft., with an available docking space of 1140ft. The width at the floor is 110ft. and the width at the coping is 138ft. The floor of the dock is 40ft. below low-water level; the sill is 35ft. below low water, and the rise and fall of the tide is 6ft. There are two compartments, the outer of which is 660ft. long and the inner 440ft. long.

SEVERAL American foundries are said to be experimenting with cast iron to which from 2 to 4 per cent. of nickel has been added. In the research department of the International Nickel Company of Canada, Limited, there has been developed a nickel bearing type of stainless steel said to contain from 20 to 40 per cent. of nickel, 6 to 12 per cent. of chromium, and 0.25 to 2 per cent. of silicon, which can be readily machined and fabricated. One rolled sample tested gave:—Tensile strength, 44.5 tons per square inch; yield point, 26 tons; elongation, on 2in., 20 per cent.; and reduction of area, 50 per cent.

IN the recently published report of the Home Office on the Grinding of Metals and Cleaning of Castings, it is suggested that sufficient care in mounting and running grindstones and manufactured wheels is not always taken, and knowledge as to their maximum safe working speeds is often lacking amongst employers and operators. The following are recommended as the maximum safe working speeds for general adoption:—Wet grindstones, 3300ft. per minute; dry grindstones, 4000ft. per minute; manufactured wheels for rough grinding, 5500ft. per minute; manufactured wheels for precision grinding, 6000ft. per minute.

WRITING on the subject of smoke abatement in the *Fuel Economy Review* of the Federation of British Industries, Professor J. O. Arnold says that when it is remembered that at the present time Sheffield furnace men are re-heating comparatively small—and though not very high in carbon, very sensitive—alloy steel ingots of a value, say, of £150 each, and that an error of judgment on their part results in the production of a "dry flame" even for a very few minutes, they may make these costly ingots scrap, it will be evident that irresponsible people who, with the best intentions, endeavour to handicap these men in their important work, by forcing them to reduce their smoke, commit something worse than a crime, namely, a blunder.

THERE are ample reserves of bituminous coal in the United States to satisfy all the needs of both the States and Canada for years to come, but the anthracite area, covering only some 484 square miles, has reserves that at the present rate of consumption will last only from eighty to one hundred years. It is, however, from a small section of this area, known as the Wyoming Valley, favourably situated as to direct transportation facilities, that Canada draws her supplies; and this field is estimated, according to a report of the Dominion Fuel Board, to last, at the present rate of consumption, not more than thirty-six years. As the exhaustion of these reserves draws near, it is certain that the price will so increase that anthracite will become a luxury fuel in fact as well as in name.

AT the Ford Motor Company, River Rouge Plant, Detroit, there is, according to the *Iron and Coal Trades Review*, under construction a 60 to 80-ton electric furnace which will be equipped with eight electrodes and transformers of 12,500 kilovolt-ampère capacity. The electrodes are arranged in two rows of four, and each pair with a contact plate under the hearth of the furnace—which is common to all—forms an electrical unit and is supplied by a 3000 kilovolt-ampère three-phase transformer. The furnace has inside dimensions of 20ft. 6in. by 10ft., and is designed on open-hearth lines, having fire-doors giving access to all parts of it, and tilting endwise. All doors are operated by air cylinders, having a definite stroke to prevent overtravel. The furnace side walls are 12in. thick, and the rear wall is given a slight arch. The roof bricks are 12in. thick, but are thickened somewhat around the ports. Tilting is carried out by a 65 horse-power motor.

WHEN metal is applied to a thoroughly clean surface by the Schoop process, the metal coating is extremely tenacious, says the *Revue de Métallurgie*. The strength of this adhesion was thoroughly proved during the war, when metallic coatings were applied to shells and other projectiles; after firing, the coating was found still adhering perfectly to the fragments of shell. Further experiments have proved that the applied metal will resist vibration, bending and even twisting without flaking off. Since the strength of adhesion on a given surface is not the same for all deposited metals, it cannot be assumed that adhesion results entirely from the interlocking of the projected particles with the minute inequalities of the surface. Of the metals most commonly used for deposition the following is their order in strength of adhesion on an iron surface:—Zinc, aluminium, lead, tin, copper and bronze. Aluminium and zinc adhere strongly to copper, as does also tin.

Miscellanea.

THE University Council, Sheffield, at a recent meeting conferred the title of Emeritus Professor of Mechanical Engineering on Dr. W. Ripper in recognition of the services he has rendered to the Department of Engineering and to the University.

ON July 2nd the Postmaster-General informed Sir R. B. Chadwick that the capital expenditure in connection with wireless stations was approximately as follows:—Leafield, £115,000; Cairo, £136,000; Northolt, £43,000; and Stonehaven, £31,000.

ALL the schools in the State of Victoria are being supplied weekly with bulletins teaching the principle of "Safety First." They are suitably illustrated and, generally, of a type to attract attention and quickly to teach the intended lesson.

THE erection of a highway bridge immediately below the Victoria Bridge between Montreal and the south shore of the St. Lawrence is recommended by the Montreal Board of Harbour Commissioners. The estimated cost of erection is 3,000,000 dollars.

ACCORDING to reports of the Russian Central Mining Administration extensive lignite beds have been discovered near Dechelobinsk in the Ural. The lignite is described as of good quality. The beds are situated in an industrial district and near a railway junction.

IT is announced that the Vaal River Barrage will be formally opened on July 27th by H.R.H. Prince Arthur of Connaught. Afterwards the pumping station at Vereeniging will be opened, and the Vaal River supply will join up with the Water Board's system.

THE Belgian Government has decided to appoint a special Commission to consider the construction of a canal from Antwerp to Liége, and another from Antwerp to the Rhine. In order to avoid undue delay, a period of six months has been assigned to the Commission for the filing of its report.

THE ship Arctic, which recently sailed from Quebec on a second visit to the Canadian Islands of the Arctic Circle, is taking out surveyors, naturalists, and engineers to investigate the resources of the Canadian Far North, and representatives of the Geological and Geodetic Survey Departments of the Dominion Government.

THE Canadian Government will advance a loan of 10,000,000 dollars to the Montreal Harbour Board for the improvement of the terminal facilities of the harbour. About 1,250,000 dollars will be used for the improvement of the Grand Trunk elevator recently taken over by the Board. New wharves and railway connections will be constructed, the present wharves reconstructed and heightened, and the basin deepened. The work will be proceeded with as soon as the detailed plans and specifications have been approved by the Government.

IT is understood that the concession granted by the Newfoundland Government to Sir W. C. Armstrong, Whitworth and Co., Limited, for the erection of large pulp and paper mills in Newfoundland, will mean the employment of some 4000 men on construction work, while the establishment of the industry will mean regular work for between 2000 and 3000 on lumbering and in the paper mills. It is proposed to develop about 100,000 horse-power at a point near Deer Lake, and to put up pulp and paper mills capable of turning out 400 tons of newsprint daily.

IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in June amounted to 692,900 tons, compared with 714,200 tons in April and 369,200 tons in June, 1922. The furnaces in blast at the end of the month numbered 222, four having been blown in and five having gone out of blast during the month. The production includes 246,700 tons of hematite, 215,200 tons of basic, 146,500 tons of foundry, and 41,600 tons of forge pig iron. The output of steel ingots and castings amounted to 767,700 tons, compared with 821,000 tons in May and 400,200 tons in June, 1922.

A SCHEME which will be soon be taken in hand by the Gwalior State is the construction of road railways on an extensive scale. The project is intended to provide easy means of transport to the province of Malwa at a low cost, as the lines will be laid on existing cart roads, connecting a number of neighbouring Native States and outlying villages. The underlying idea is to build a steam transport system on cheap lines, thus replacing the existing slow bullock cart transport. The estimated cost per mile of this railway is 8000 rupees. The work will soon be taken in hand by the Public Works Department which is under the charge of Mr. Hashmar Ullah.

IT is reported in the *Canals and Waterways Journal*, that Mr. A. J. Harmsworth, of North Camp, Aldershot, is negotiating for the purchase of the Basingstoke Canal. The Basingstoke Canal was completed in 1796, the Act having been obtained in 1778. In 1895 the canal was purchased by the Woking, Aldershot and Basingstoke Canal and Navigation Company, but little has been done with it, and there was danger of its becoming derelict. The canal commences at the Wey, about two miles from the Thames, and proceeds for 37 miles through the counties of Surrey and Hampshire to Basingstoke. There are twenty-nine locks in the first 15 miles, ascending 195ft. The remaining distance is level.

DURING the heavy thunderstorm which lasted practically the whole of the night of July 9th–10th, much damage appears to have been done by lightning. At certain times there was an average of 50 or 60 brilliant flashes to the minute. The electricity supply at Isleworth and West Ham failed for a time in certain quarters and, according to *The Times*, while the telegraph and radio services were unaffected, both working quite smoothly throughout the storm, the telephonic service suffered severely. In the London area on July 10th, three thousand subscribers' lines, out of a total of 202,000, were reported to be out of order. The southern district was the most affected—1112 of the lines were in that area, a large proportion of these being in Kingston and Richmond. In the north-eastern district the number was 774 and in the north-western district 710.

THE PENISTONE WORKS OF CAMMELL LAIRD AND CO., LIMITED

(*For description see page 62*)

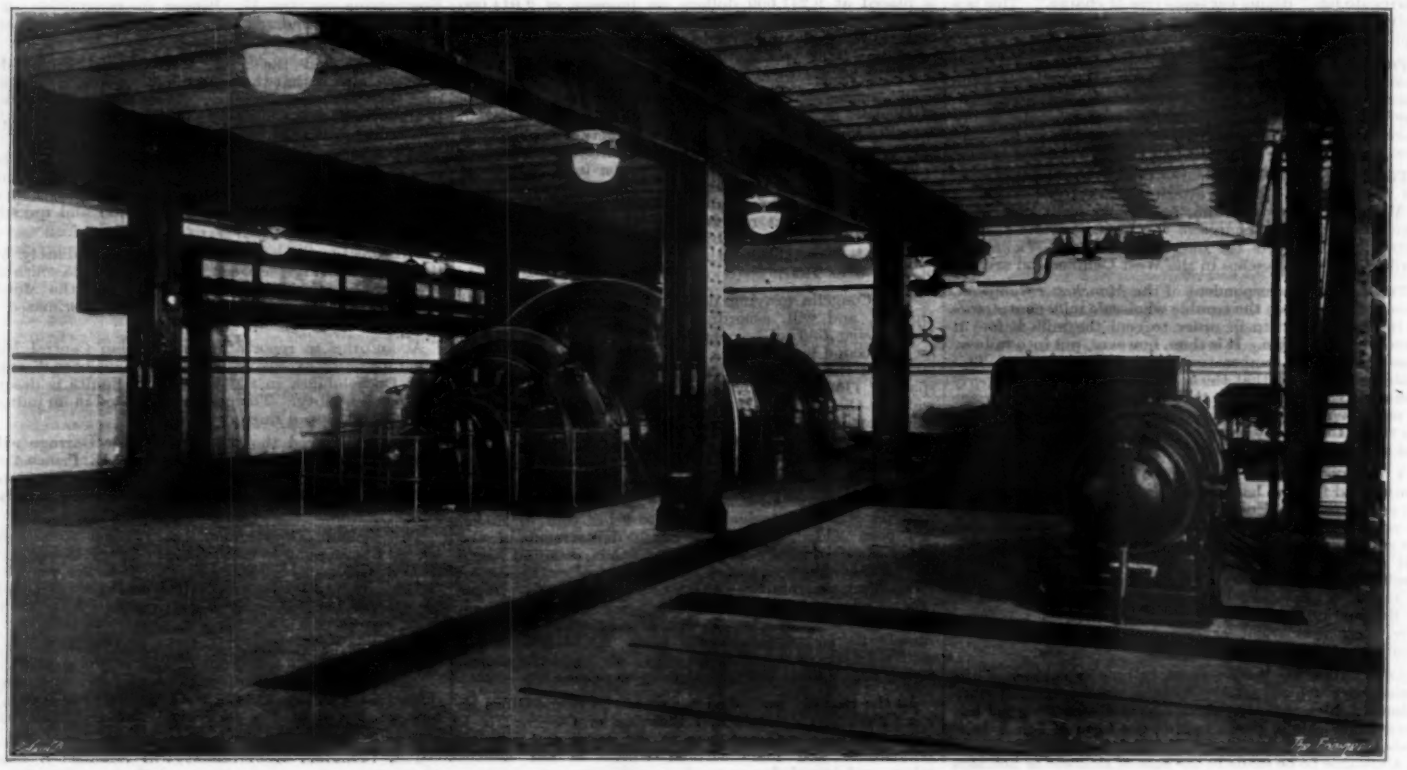


FIG. 11—VIEW OF DRIVE PIT OF 34-INCH ROLLING MILL

FIG. 12—ELECTRIC SUB-STATION ON NEW SIDE OF WORKS

AGENT ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—MITCHELL'S BOOK STORE, 676, Cangallo.
CHINA.—KELLY AND WALSH, Limited, Shanghai and Hong Kong.
EGYPT.—CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.
FRANCE.—BOYVEAU AND CHEVILLET, Rue de la Banque, Paris.
CHAPELOT AND CIE., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. COMBRIDGE AND CO., Bombay; THACKER AND CO., Limited, Bombay; THACKER, SPINK AND CO., Calcutta.
ITALY.—MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umbarto 1, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.
JAPAN.—MARUZEN CO., Tokyo and Yokohama.
AFRICA.—WM. DAWSON AND SONS, Limited, 7, Sea-street (Box 49), Capetown.
C. JUTA AND CO., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—GORDON AND GOTCH, Limited, Melbourne, Sydney, Brisbane and Perth, &c.
MELVILLE AND MULLEN, Melbourne.
ATKINSON AND CO., Gresham-street, Adelaide.
CANADA.—DAWSON, WM., AND SONS, Limited, 87, Queen-street East, Toronto.
GORDON AND GOTCH, Limited, 132, Bay-street, Toronto.
MONTREAL NEWS CO., 386–388, St. James-street, Montreal.
TORONTO NEWS CO., 42, Yonge-street, Toronto.
CEYLON.—WIJAYARTNA AND CO., Colombo.
JAMAICA.—EDUCATIONAL SUPPLY CO., Kingston.
NEW ZEALAND.—GORDON AND GOTCH, Limited, Wellington and Christchurch; UPTON AND CO., Auckland; J. WILSON CRAIG AND CO., Napier.
STRAITS SETTLEMENTS.—KELLY AND WALSH, Limited, Singapore.
UNITED STATES OF AMERICA.—INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York; SUBSCRIPTION NEWS CO., Chicago.

Agents Abroad for Advertisements.

UNITED STATES OF AMERICA.—BRITISH AND COLONIAL PRESS, Inc., 736, The Knickerbocker Building, 152, West 42nd-street, New York City.
FRANCE.—AGENCE VOX, 7, Rue de Surène, Paris (VIIIe).
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

SUBSCRIPTIONS.

THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive THE ENGINEER weekly and post free. Subscriptions sent by Post Office Order must be made payable to THE ENGINEER and accompanied by letter of advice to the Publisher.

THIN PAPER COPIES.		THICK PAPER COPIES.	
Half-yearly ..	£1 11s. 6d.	Half-yearly ..	£1 13s. 9d.
Yearly ..	£3 3s. 0d.	Yearly ..	£3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum
Thick paper edition .. .. £3 3s. 0d. „

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

ADVERTISEMENTS.

*** The charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "THE ENGINEER Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication) ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of THE ENGINEER.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** *With this week's number is issued as a Supplement a Two-page Plate illustrating the Electrical Equipment of a 19,000 B.H.P. Mill Motor at the Penistone Works of Cammell Laird and Co., Limited. Every number as issued by the Publisher contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, July 20th, 1923. PAGE

A SEVEN-DAY JOURNAL .. 59
THE ST. JAMES'S PARK AND OTHER LONDON LAKES.—No. I. (Illus.) .. 60
THE PENISTONE WORKS OF CAMMELL LAIRD AND CO., LIMITED.—No. III. (Illus.) .. 62
GAS-DRIVEN ALTERNATORS FOR SOUTH AFRICA.—No. II. (Illus.) 64
INTERNATIONAL NAVIGATION CONGRESS.—No. III. .. 65
THE ENERGY OF THE FUTURE .. 67
CONVERSAZIONE OF THE INSTITUTION OF CIVIL ENGINEERS. (Illus.) 68
LLOYD'S REGISTER OF SHIPPING .. 69
LETTERS TO THE EDITOR—
The Herbert Pendulum Hardness Tester .. 70
Railway Speeds .. 70
Gas-driven Alternators for South Africa .. 70
RAILWAY MATTERS .. 71
NOTES AND MEMORANDA .. 71
MISCELLANEA .. 71
LEADING ARTICLES—
Boundary Lubrication .. 73
Castings or Forgings? .. 74
RAILWAYS IN BOLIVIA .. 74
THE SWEDISH NAVY. (Illus.) .. 76
NEW STEAM TURBINE DESIGN .. 76
A THAMES-SIDE MOTOR CAR WORKS. (Illus.) .. 77
AN ACCOUNT OF AN EXAMINATION OF THE MENAI SUSPENSION BRIDGE .. 78
CHINESE ENGINEERING NOTES .. 78
SIXTY YEARS AGO .. 79
DOUBLE-ACTING FOUR-CYCLE ENGINE. (Illus.) .. 79
COPPER IN THE UNITED STATES .. 79
A CANADIAN MOTOR CAR FERRY. (Illus.) .. 80
TICKET MACHINES IN RAILWAY STATIONS .. 81
NEW LIFEBOAT AND LAUNCHING SLIP AT CROMER .. 81
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 81
Lancashire .. 82
Sheffield .. 82
North of England .. 82
Scotland .. 83
Wales and Adjoining Counties .. 83
LATEST NEWS FROM THE PROVINCES .. 83
CURRENT PRICES FOR METALS AND FUELS .. 84
FRENCH ENGINEERING NOTES .. 85
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 85
FORTHCOMING ENGAGEMENTS .. 86
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 86
CATALOGUES .. 86

DEATH.

JULY 14th, at Felixstowe, from pneumonia, CECIL, eldest son of the late T. B. LIGHTFOOT, aged 50 years.

THE ENGINEER.

JULY 20, 1923.

Boundary Lubrication.

THE paper read by Dr. Stanton before the recent Air Congress in London—a paper identical in subject, if not in word, with the article which he contributed to our issue of June 29th—raised a considerable amount of fresh interest in connection with modern views regarding the mechanism of lubrication. Those who still hold to Osborne Reynolds' interpretation of Beauchamp Tower's experimentally determined results, who hold, that is to say, that all the phenomena of lubrication in every instance are in accordance with, and can be explained by means of, the laws of hydro-dynamics, will find that Dr. Stanton has returned to the attack and has prepared fresh evidence in support of the view advanced by Hardy, Deeley and others, that under certain conditions hydro-dynamical lubrication ceases and boundary lubrication—a matter of molecular physics—takes its place. Exactly how boundary lubrication is to be defined with strictness and brevity we do not know, but to the engineer it may be helpful if we here give a picture of it as presented to us on one occasion by Mr. R. M. Deeley. In the case of a white metal bearing resting on a steel journal, we are to imagine that passing radially outward there is, at the point of nearest approach, first a layer of steel molecules, next a layer representing a union of some sort between the molecules of the steel and those of the lubricant, then a layer of oil molecules, which is succeeded by a layer of oil-and-white-metal molecules, and, finally, a layer of white metal molecules. If the intermediate stratum of pure oil is reduced to a thickness of one or two molecular diameters—or if, or so we understand, it is entirely absent and the metals are separated only by the absorbed layers—the conditions of boundary lubrication arise, conditions which must obviously be totally different from those found in the case of a bearing in which the lubricating film is many thousands or millions of molecular diameters in thickness. In considering this matter, two questions obviously intrude themselves upon our attention. In the first place, is the experimental evidence at present available sufficient to justify us in believing in the possibility of boundary lubricant? Secondly, if the fact of boundary lubrication can be established, what effect will the recognition of its possibility have upon engineering practice?

We may conveniently attempt to answer the second question first, for its answer may help to remove the impression that the whole matter is one very largely of academic interest. From the practical point of view, it should be at once apparent that boundary lubrication, if it exist and if it can be established in bearings running under commercial as distinct from laboratory conditions, would, when relied upon, result in a very considerable saving of costly lubricant. That, we take it, would be the principal advantage immediately gained by the deliberate adoption or encouragement of boundary lubrication in engine and machine bearings, although practical engineers may well consider any such saving as likely to be dearly purchased until they know more than they do at present regarding, not only the conditions required for the establishment of boundary lubrication, but also the liability to disappear of what is apparently the perilously narrow margin between the conditions of boundary lubrication and those of seizing. From a second aspect, the definite establishment of the phenomenon of boundary lubrication would also react on practice, although, possibly, not immediately. Granted that it may exist, it seems to follow inevitably that the nature of the lubricant and the nature of the bearing surfaces must exercise an important influence on the efficiency of our efforts to reduce friction and not be wholly without effect as, with the exception of the factor of viscosity, they are regarded as being in Reynolds' theory. Whereas the hydro-dynamical theory of lubrication provides little or no incentive to the undertaking of research designed to improve the efficiency of lubricated surfaces, the theory of boundary lubrication suggests many fields for investigation in this respect and holds at least a promise of much possible practical gain. It is, perhaps, worth noting in this connection that the requirements for boundary lubrication appear, in many respects, to be totally different and, in some cases, exactly opposed to those to be observed with thick oil films. A nice example is to be found in the matter of oil grooves. Although such grooves are still sometimes formed in bearings supposed to be lubricated in accordance with Reynolds' theory, it has been known since Tower's time that they effectively prevent the establishment of an oil film. On the other hand, Dr. Stanton appears to have proved that, in reciprocating motion at all events, their presence is essential if boundary lubrication is to be effected. In passing it may be remarked that those who have achieved satisfactory lubrication with grooved bearings may have done so because, unconsciously, they were providing the conditions requisite for boundary lubrication, and were, equally unconsciously, obtaining it. As to the second question, we feel that there is nothing anti-physical in the conception of boundary lubrication, and that to deny the possibility of its establishment would leave us with a legacy of experimentally determined facts which it would be very difficult, if not impossible, to explain without severely straining the laws of hydro-dynamics. While, however, we are more or less prepared *a priori* to accept boundary lubrication as a broad principle, we have some hesitation in regarding the experimental evidence so far adduced in its support as approaching completeness. If we confine ourselves to Dr. Stanton's own work on the subject, it must be confessed that the facts of observation seem to be somewhat inconclusive. His earliest experiments were conducted on the Lanchester worm-gear testing machine and showed that animal and vegetable oils were superior to mineral oils as regarded the temperature at which the gear could be run without incurring a serious increase in friction. From this fact he argued that boundary lubrication prevailed, but to us it seems that it afforded very little evidence one way or the other, and certainly none of a direct nature. Dr. Stanton next experimented with a semi-circular bearing on a rotating shaft under conditions of load, &c., designed to produce boundary lubrication. As he reported in his Hawksley lecture last December, he found, however, that even in the most favourable case the surfaces were separated by a film of oil estimated at about 5000 molecular diameters in thickness, and that all the figures observed or deduced were in close keeping with those predicted by Reynolds' hydro-dynamical theory. He has since experimented again with, this time, a grooved journal mounted to swing pendulum-wise in a grooved bush, and has definitely come to the conclusion that boundary lubrication was present, and that it will be present, in all suitably grooved bearings in which the relative movement is of a reciprocating nature. While the evidence thus

afforded is satisfactory so far as it goes, the special nature of the apparatus and motion employed in its establishment undoubtedly deprives it of much of the convincing power which it would have had had it been obtained by means of the plain half-bearing and continuous rotation used in the second form of test.

So far we are not justified in believing, solely in the light of actual investigations carried out up to the present, that boundary lubrication can be made to prevail in all forms of bearing having any type of motion. We are not justified, at least on Dr. Stanton's results, in believing more than that it may be established in specially grooved bearings having relative reciprocating motion. For all we know to the contrary, the facts disclosed in his Hawksley lecture may be the first evidence to the effect that it cannot be established in plain bearings with continuous rotating motion. On the other hand, in the light of modern knowledge, the long experience and custom of the engineer supply, apart from specifically designed experiments, some considerable amount of confirmatory testimony as to the existence of boundary lubrication or something very like it. Were lubrication always a matter of hydro-dynamics, as it is according to the Reynolds theory, the particular nature of the bearing surfaces, once the oil film was established, would have no influence on the inter-superficial friction, nor would the properties of the lubricant other than its viscosity. In practice, however, it has long been the custom to specify particular metals for bearings, although to do so is quite inconsistent with a belief in thick film lubrication. We must, in fact, either accept boundary lubrication or regard the whole family of "anti-friction" metals as hopeless pretences. Then, in the matter of oil grooving, to which we have already referred, it seems absurd to suggest that this practice, which is still in vogue among many engineers, is based in flat opposition to true theory. Rather may we suppose that practice, in this respect as in so many others, has blindly found the truth while theory has been pursuing a false trail. The most striking instance afforded by practice of the insufficiency of the Reynolds theory is, however, in our opinion, presented by the known effect of adding small quantities of fatty acid to mineral lubricating oils. According to the hydro-dynamical view, the nature of the lubricant is immaterial, its viscosity alone affecting the result. Yet to take some figures recorded by Dr. Stanton, figures which are amply borne out by practical experience, the addition of 1 per cent. of oleic acid to Bayonne oil, an amount quite insufficient to have any noticeable effect on the viscosity, reduced the co-efficient of friction in a bearing by no less than 17 per cent. Practice thus provides more than one striking illustration of the establishment of boundary lubrication conditions. It is therefore difficult to believe, as some do, that boundary lubrication is a myth invented by certain physicists and research workers.

Castings or Forgings?

IN a paper on "The Development of Aero-Engine Materials," Dr. L. Aitchison, at the International Air Congress, advanced a strong plea for the use of forgings or of wrought materials in place of castings throughout aeronautical engines. He based this plea on the well-known facts regarding the existence, in many castings, of serious internal defects, which cannot be detected with certainty even by careful inspection. In aero-engines, where extreme lightness in relation to power output is essential, he suggested that it is wrong to use castings at all, and that at least all parts which are exposed to stress should be constructed of more expensive but also more reliable wrought metal. It is true, of course, that the aero-engine occupies a very special position, and that even if the policy advocated by Dr. Aitchison were adopted, it would not directly mean a very great deal to the foundry industry nor to general engineering practice. None the less, the advocacy of such a policy reveals a state of affairs in regard to castings and foundry practice in general which requires careful consideration.

We have, in the first place, the proposition that castings of the kind used in aero-engines cannot be made reliably sound, and that unsoundness cannot be unfailingly detected That unsoundness may, from time to time, occur in any casting must be admitted; that it must be accepted as a regular feature is going beyond the truth. If that were really the case, neither forged nor rolled material could be relied upon to be sound, since defects in the block of cast metal—the slab or ingot, from which all rolled metal and forgings originate—are transferred in a modified form to the bar or sheet or forging. The fact suggested by Dr. Aitchison's contention, and supported by wide experience, that wrought metal is, as a rule, reliably sound, suggests that the simple slabs and ingots produced for subsequent forging or rolling are regularly made of satisfactory soundness. The difference between these simple castings and those used as castings in the ordinary sense of the term is, then, the vital factor, and that difference resides only in the complexity of shape required in the usual casting. The wide-spread presence of defects in these castings, therefore, constitutes, in reality, a challenge as much to the designing engineer as to the foundryman. While the foundryman will, no doubt, try his utmost to make a good casting to the designs submitted to him, it is for the engineer to avoid the use of castings whose shape and arrangement of masses makes it all but impossible to cast them. It would seem possible, therefore, instead of going direct to the extreme of using only rolled or forged material, to adopt the compromise of using castings of simpler design, and especially of design adapted to the needs of the foundry. Closer co-operation between designer and foundryman is clearly needed here. Furthermore, the use of castings of simplified design should also facilitate inspection, leading to the detection of internal defects. The application of X-ray examination is by no means out of the question, particularly in the case of aluminium alloy castings, while it was also suggested in the discussion on the paper in question that determinations of density on entire castings could be made without undue difficulty and were capable of giving very clear indications of unsoundness.

While it may not be a matter of great moment to the majority of foundrymen whether castings are, or are not, replaced by forgings or by constructions built up of rolled material, in the special case of aircraft, it is more than possible that such a policy if once adopted for this most exacting class of work might spread to other fields. There is a strong tendency in the higher classes of automobile practice to follow the lines of aircraft construction, particularly in regard to the materials employed, and here we enter a field which is of much wider importance to foundrymen. Such a consideration strongly suggests that the art of the founder—and its scientific foundation—are not as fully developed as they should be, and that, if the product of the foundry is to hold its own in modern engineering developments, it requires very considerable improvement. Some branches of the foundry industry appear to be alive to such a need. There is, for instance, a fairly well-supported effort in progress to secure the application of research to the problems of die casting. There is also a "Cast Iron Research Association." The aluminium and brass and bronze foundry industries, however, do not appear to be making any very vigorous effort, while steel castings, on the whole, still remain under a ban of serious suspicion on this very ground of unsoundness. There would seem to be in several directions in connection with the production of castings, urgent need for progress and for special activity both in the foundries and in the research laboratories. Castings have too long been regarded as a sort of metallurgical Cinderella, for which "anything will do." Dr. Aitchison's paper and the discussion which followed it may be taken as a warning that only the best possible will do for aeroplane work, and that founders must look to their laurels. Fortunately, indications that great advances could be made were not wanting.

Railways in Bolivia.

RAILWAY development in Bolivia is becoming active under the policy of the Government for providing interior communication and also connection with the railways of adjacent States. The most important work now under way is a 124-mile extension of the main north and south arterial line from Atocha to Villazon, to connect it with a line of the Argentine Government railways. This connection will not only promote commerce but will open a direct route from Bolivia to the Atlantic coast. It will, in fact, complete an indirect but practicable Transcontinental route from Argentine ports on the Atlantic through La Paz, Bolivia, to the Pacific ports of Mollendo, Peru, and Arica, and Antofagasta, Chile. However, the Argentine railways are building a more direct line to Antofagasta. In addition to this line now under construction the Bolivian Government is advertising for tenders for the extension of the Cochabamba Railway to Santa Cruz, 390 miles, and it is expected that the completion of the Potosi-Sucre Railway to Sucre will also be undertaken.

The Atocha-Villazon extension was in the first place undertaken by a French company, and later by an Argentine firm, and it is now being built by an American company. In July, 1921, the Ulen Contracting Company, of New York and Chicago, entered into an agreement with the Government of Bolivia to finance and construct this extension, connecting with the Argentine Government railway system at La Quiaca, which is across the frontier from Villazon. A review of the railways of Bolivia was given in the November number of *Ingenieria Internacional*, a technical paper published in New York for circulation in Latin-America, and from that article much of the following information has been condensed. The article is authoritative, it having been written by Mr. F. Lavis, of New York, who is consulting engineer for the Government in the construction of the Atocha-Villazon extension. Mr. Lavis points out that the completion of this line and of the Potosi-Sucre Railway will complete the first stage of the railway development programme proposed by President Montes in 1906 after the settlement of the Acre dispute with Brazil.

At present Bolivia is an inland country entirely, having lost its former maritime provinces on the Pacific coast, partly as a result of its participation in the dispute between Chile and Peru. Its transportation problem, therefore, is not only to open communication between its principal cities and departments, but also to establish connections with the railways of adjoining States in order to open up communication with the outside world. In 1906, after the Treaty with Brazil above mentioned, the Bolivian Government made an agreement with Messrs. Speyer and Company and the National City Bank of New York, whereby the Government would subscribe the £1,200,000 received from Brazil and the financiers would subscribe £3,750,000 additional for an issue of bonds to be used in the construction of a system of railways. A construction company was then organised by the financial interests. At that time there were only two railways in Bolivia:—First, a short line from La Paz, the capital, to Guaqui, on Lake Titicaca, elevation 12,600ft., with steamer service to Puno, connections with the Southern Railway of Peru, which gave access to the port of Mollendo; and, second, the Antofagasta and Bolivia Railway from Oruro through Uyuni and terminating at the Chilean port of Antofagasta.

Although the Southern Railway of Peru, built in the 'seventies, was of standard gauge, the La Paz and Guaqui line, opened in 1902, was of metre gauge, which was later adopted as the official gauge for the Bolivian railways. The Antofagasta line was built originally of 30in. gauge, but when the present British company—Antofagasta and Bolivia Railway—acquired control of the Bolivian portion of the line, the gauge was changed to metre gauge on the section from Uyuni to Oruro. This change was made in 1915–16. The section from Uyuni to Antofagasta is still of 30in. gauge. Under the American or Speyer agreement extended surveys were made, and a main line was built from Viacha, near La Paz, to Oruro, thus opening communication between the capital and the port of Antofagasta. But in 1908 the American financiers sold their interests to the British concern noted above—the Antofagasta and Bolivia Railway Company.

In the topography of Bolivia the main characteristics is a central plateau between two ranges of the Andes, this plateau being at an elevation of 12,000ft. to 13,000ft., and extending south into Argentina. Much of this plateau is desert, and in general it is cold and bleak. The country's wealth is mainly in its mineral resources; it is one of the most important producers of tin, and has also copper, gold, silver, lead, wolfram and bismuth. The principal mines are in the eastern or main range of the mountains. The principal cities are La Paz, with a population of 55,000; Oruro, Cochabamba, Potosi, Sucre, Uyuni, Santa Cruz and Tarija. An extensive agricultural and cattle district may be developed in the lowlands of the eastern portion of the country, on the headwaters of the Amazon and the Paraguay, but the commercial outlet for this district will be eastward through the valleys of the great rivers crossing Brazil. Oilfields may be developed here. For the connection of this district with the central section of the country and with the capital, it is thought that highways for motor vehicles may be found more economical than railways. Railways from the Pacific coast have to climb the coast range to passes at elevations of 13,000ft. to 14,000ft. to reach the Bolivian plateau, and then again climb the main range to passes at about 16,000ft., beyond which there is a long slope to the lower country. In general, the coast range is the easier to surmount; but, nevertheless, it requires heavy work, except on the route of the Antofagasta line.

The railway system of Bolivia—as shown in the map, Fig. 1—may be divided into three classes:—First, the Bolivian Railway, the main arterial line running south from the capital to Atocha, and now being extended south to a connection with the Argentine railway system; second, three lines extending eastward from this main artery; and third, three lines to the coast, including the portions through foreign States. The capital city—La Paz—lies in

a deep valley below the general level of the central plateau, and is reached by three railways. The Guaqui–La Paz line runs from Viacha to the rim of the valley and drops into it by an electrically operated line of 6 per cent. gradient. The Bolivian Railway also descends from Viacha but with a distance of 9 miles in order to obtain maximum gradients of 3 per cent. The Arica–La Paz Railway connects with the Bolivian Railway at Viacha and runs over its line into La Paz. On most of the Bolivian railways the maximum gradients are 3 per cent. which

FIG. 1—SKETCH MAP SHOWING RAILWAYS IN BOLIVIA

are used extensively, but on the Yungas Railway—noted later—there are gradients of 6 per cent. Curves are generally limited to 328ft. radius, although 275ft. curves are employed occasionally. Flange rails of 60 lb. and 65 lb. are laid on wooden sleepers from Chile and the United States or on 90 lb. steel trough sleepers. The locomotives are of English, American and German manufacture, and the rolling stock is generally of the American type, but with compartment sleeping cars. On the main lines of the Bolivian Railway the service is generally good and the trains generally are on time.

BOLIVIA–ARGENTINE LINE.

The project for connecting the railways of Bolivia with those of Argentina dates back to 1892, when reconnaissance surveys were made for the so-called Pan-American railway to extend from the United States to Patagonia. The Bolivian line followed the general route of the surveys. In 1908 the Argentine Government railways reached La Quiaca, on the Bolivian frontier, and proposals were then made that the Argentine Government should continue its line as far as Tupiza, while the Bolivian Government would build south from Uyuni to Tupiza. The former section was not started, however, but the latter section was built from Uyuni as far as Atocha and was opened in 1913. At that time the Government obtained a loan from France, and as a result a contract was given to the French firm of Vezin and Co. to build north from La Quiaca to Tupiza. After earthwork and bridging had been done on about 36 miles, operations were stopped owing to lack of money and to the outbreak of the War. Later, this contract was cancelled and a new construction contract was made with Lavenas, Poli and Co., of Buenos Aires. Work under this contract was suspended in April, 1921.

In July, 1921, the Ulen Contracting Company, of New York and Chicago, entered into an agreement with the Bolivian Government to finance and build the entire connecting line from Atocha to La Quiaca. The original agreement was that the company would take a Government bond issue of £1,700,000 and have the work finished in five years; but later the terms were changed to £2,000,000, and the completion of the line by July, 1925, while the section from Tupiza to La Quiaca is to be completed by the end of 1923. A plan and longitudinal section of the line are shown in Fig. 2. From Atocha, at an elevation of 9840ft., the surveyed line rises to a summit elevation of 13,307ft. in 13 miles, whence it descends with gradients of 3 and 2 per cent. to Nazareno, at an elevation of 9184ft. Another ascent on 3 per cent. gradients for 15 miles reaches an elevation of about 7870ft., which is maintained to La Quiaca. The total length of this link will be about 124 miles, and its longitudinal section is shown in Fig. 2. The work started by Lavenas, Poli and Co. is again in progress, that firm now working under the direction of the Ulen Contracting Company.

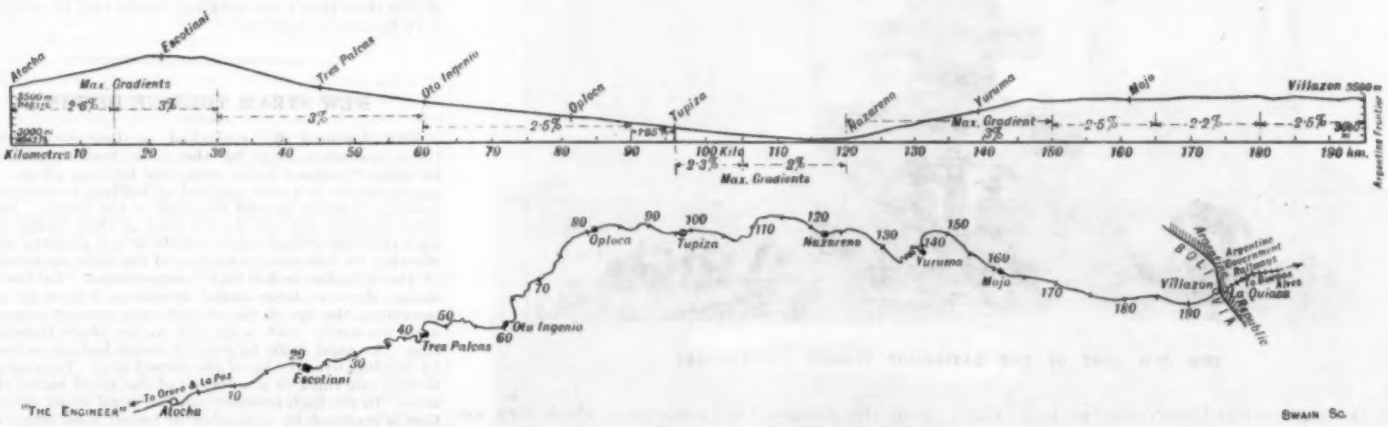


FIG. 2—LONGITUDINAL SECTION AND PLAN OF LINE BETWEEN ATOCHA AND LA QUIACA

Very heavy earthwork is involved where the sharp descending gradient follows along the river. Deep cutting of the steep slopes was undesirable, as the broken character of the shale is likely to cause extensive slips if it is disturbed. Much of the line, therefore, will be on side-hill embankments, the slopes of which extend far out into the river bed. For the greater part of the year the river is dry and its bed serves as a highway, but flood-waters pouring down the steep channel make it necessary to protect the slopes of the embankments with heavy stone revetment.

INTERIOR LINES.

The three railways extending eastward from the main north-and-south line are the Yungas Railway, the Cochabamba Railway, and the Potosi–Sucre Railway. The Yungas Railway, which is intended to reach the headwaters of the Amazon, is a Government line starting near La Paz. It, at present, has only 30 miles in operation, with earthwork partly completed for an additional 10 miles. A summit elevation of 15,300ft. is reached in 15 miles, beyond which is the beginning of the long eastward slope. With gradients of 6 per cent. the line is operated by geared locomotives of the Shay type. Curves up to about 200ft. radius are employed, the gradients being compensated or reduced on curves.

The Cochabamba Railway leaves the main line at Oturo—elevation 12,122ft.—and ascends to a summit pass of 14,000ft. elevation in 34 miles, beyond which the line descends the eastern slope with gradients of 3 per cent. It is located largely on steep hillsides in unstable shale strata subject to slips. In flood time the river attacks the slopes and the embankments to a serious extent, the river channel itself having a gradient of nearly 3 per cent. Protection walls of "one-man" stones wrapped in sheets of wire netting were tried, but a later method of checking this flood erosion consists in building large blocks or piers of stone masonry and allowing them to settle in place as the supporting material is washed away.

This line was opened in 1917, and the Bolivian Government has invited tenders for its extension from Cochabamba to Santa Cruz, a distance of 390 miles, together with a 40-mile branch. The elevations are 8446ft. for the former, and 1380ft. for the latter place. The extension is to be on the metre gauge, with 3 per cent. maximum gradients, and will be laid with 60 lb. rails. Tenders are to be opened in June, 1923. A further extension to Yacuiba, in Argentina, or to Corumba, Brazil, is projected. Oilfields are being developed around Santa Cruz.

The Potosi-Sucre Railway, opened in 1912, extends east from Rio Mulato on the main line, and in 50 miles reaches a summit elevation of 15,814ft. It has 3 per cent. gradients and 328ft. curves, like the Cochabamba line, but is in easier country with more stable ground. The extension beyond Betanzos to Sucre, however, will require much heavier construction. This extension is being built by the Bolivian Government.

COAST LINES.

Of the three lines to the Pacific coast, the Antofagasta and Bolivia Railway—30in. gauge—is remarkable as being a mountain line which ascends to an elevation of 13,000ft. on gradients of 1 in 50 with little earthwork, easy curvature and no large bridges. It is laid mainly with 60 lb. rails, and as it is in a dry district it requires comparatively little maintenance work.

The Arica-La Paz Railway is a metre-gauge line with maximum gradients of 3 per cent., except for 26 miles of a rack-rail section having gradients of 6 per cent. The third line is the Southern Railway of Peru, a standard-gauge line from Mollendo to Puno. This is a typical mountain railway, having long 3 per cent. gradients, sharp curves and heavy earthwork.

The Swedish Navy.

THE Swedish squadron that visited British waters between July 2nd and 11th, contained three vessels which are of particular interest as specimens of naval architecture, viz., the flagship Sverige and her consorts, Drottning Victoria and Gustaf V. All are practically identical in design. Sweden's navy is, primarily, a coast defence organisation, and its ships cannot, of course, be compared with the huge Dreadnoughts maintained by wealthier Powers. But, considered purely as coast service ships, the three we have named are exceptionally formidable for their size. In the pre-Dreadnought era they would have been regarded as an excellent type of second-class battleship, and even under present conditions they are superior in all respects to the best armoured ships of other coast-defence navies, such as the Netherlands, Danish and Norwegian. Restricted for financial reasons to a displacement of 7600 tons, their designers were called upon to provide machinery for a speed of 22.5 knots, a main armament of four heavy guns, and substantial armour protection. The ships, moreover, were required to possess good sea-keeping qualities, involving a fairly high freeboard. All these demands have been met in a way that reflects very great credit on Sweden's naval constructors.

The Sverige herself was built in somewhat unusual circumstances. Her construction was authorised in 1911, but a few months later a change of Government took place and the contract was cancelled, the Liberal administration proposing to purchase torpedo-craft and submarines instead. This decision was badly received by the country, and a popular fund was established for the purpose of collecting sufficient money to build a battleship. So generous was the response, particularly from the rural provinces, that in a short time a sum of £960,000 had been collected. Meanwhile the plans for the Sverige had been revised, the displacement being increased from 6800 tons to 7600, to permit of various improvements being added. She was laid down in April, 1913, at the A. B. Götaverken, Gothenburg, and went afloat two years later. Excepting armour, the whole of the material in the ship is of Swedish manufacture. The armour plates were ordered in the United States. In the summer of 1915 the Drottning Victoria and Gustaf V. were begun to the same design, but both these ships were greatly delayed by the non-delivery of their armour plate from America, and they were not completed till 1921.

The cost of the Sverige was, approximately, £670,000, that of her consorts being somewhat higher. Her leading dimensions are: Length on water-line, 392.8ft. (396.5ft. in the two later ships); beam, 61ft.; maximum draught, 22ft.; displacement, 7600 tons. The Sverige is equipped with four sets of Curtis turbines, built by the Kockum Company, of Malmo, which transmit 20,000 horse-power to four shafts, giving a speed of 22.5 knots. There are twelve Yarrow coal-fired boilers fitted with oil sprays. Normally, 350 tons of coal are carried, but the maximum bunker capacity is 700 tons of coal and 100 tons of oil. On her trials the Sverige reached a maximum speed of 23 knots. The two later ships have Westinghouse turbines of 22,000 shaft horse-power with reduction gearing, and two screws.

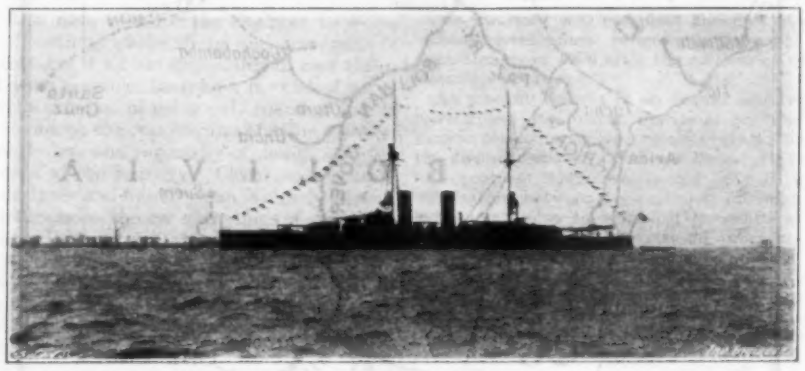
The following trial results of the Drottning Victoria have been published:—

Shaft horse-power	24,800 ..	11,045 ..	2,228
Revs. per minute, turbines ..	3,760 ..	2,939 ..	1,810
Revs. per minute, propellers..	210 ..	167 ..	101
Speed in knots	23.6..	19.2..	12.3

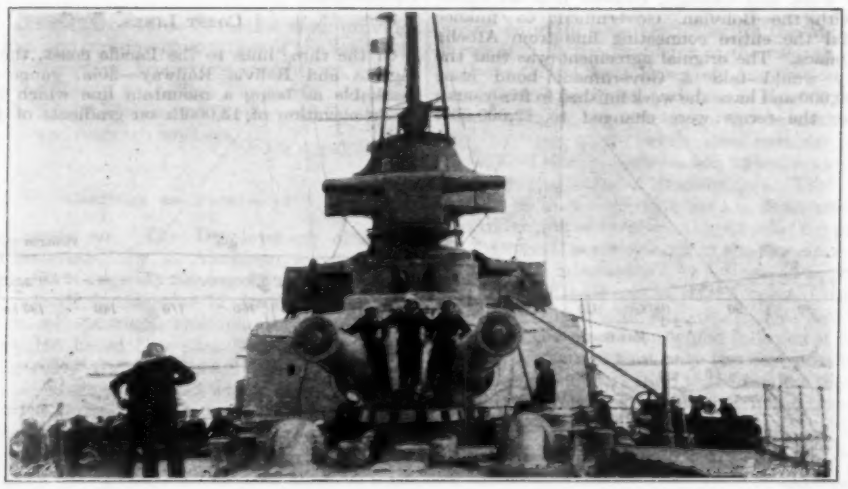
The appearance of the three ships is practically uniform, except that the Sverige has a ram bow, while each of her sisters has a straight stem strengthened for ramming. The lines of the hull are graceful, with a slight sheer and moderately flared bows. Forward of the bow turret the deck is raised about 3ft. and well cambered. Those who serve in them speak highly of the nautical qualities of the ships, which appear to be excellent sea-boats considering the heavy weights they carry above deck. For about one-third of the length amidships there is a narrow belt of 8in. Carnegie steel; it is continued to the bow and stern at a thickness of 6in. Above this main belt is an upper strake of 4in. armour, rising as high as the gun deck. There is a continuous steel deck, 1½in. to 2in. thick, which is carried down over the steering gear aft and also at the bows, where it reinforces the ram. The subdivision of the hull is very good, and the coal bunkers are so arranged as to protect the machinery and magazine spaces from under-water attack.

Four 11in. 45-calibre guns, built by the Bofors Company, form the main armament, paired in turrets at bow and stern. These guns weigh 41 tons each, and discharge a 760 lb. projectile with a muzzle velocity of 2576 foot-seconds. The breech action is on the screw interrupted-thread principle. Manœuvred by electricity they can be loaded in 17 sec. The turrets, built of 8in. steel, are rather cramped for space, as there is a bulkhead between the guns and a control station for the O.O.T. at the rear. The mountings are designed for firing at a high angle, probably 25 deg. at least, but at normal elevation the upper part of the gun-port is covered by a hinged embrasure piece, which is raised when maximum elevation is desired. The structure of the barbette does not differ essentially from British practice. Eight 6in. guns of 45 or 50-calibre are carried as a secondary armament. Two of these are twin-mounted in a centre line turret immediately abaft the forward 11in. guns, over which they are able to fire directly ahead. The remaining six guns are mounted in single turrets on the broadside. Fire concentration is, therefore, as follows:—Ahead, two 11in. and four 6in. guns; astern, two 11in. and two 6in.; broadside, four 11in. and five 6in. The smaller turrets are built up of 5in. to 3in. armour. There are also six 14-pounder guns, two of which are on high-angle mountings for use against aircraft; two 6-pounder saluting guns, and several machine-guns. In a spacious torpedo flat in the forward part of the ship there are two 18in. submerged tubes manufactured at Elswick. One tube is mounted on each side. Six 18in. Whitehead torpedoes are carried in the flat, with slings for as many more. All the main and secondary guns are controlled from a director tower placed on the light tripod foremast. The Sverige now carries above the conning tower a large range-finder in an armoured hood, but the other ships lack this fitting. In spite of their relatively small displacement, high-powered machinery and heavy armament, the ships are by no means crammed for space below deck. The ward-room, it is true, is rather small, but the officers' cabins and the mess decks are commodious enough, and the ventilation system throughout seems wonderfully efficient.

Most of the above details were gleaned by a representative of THE ENGINEER, who, on July 3rd, spent several hours on board the Sverige at Sheerness, thanks to the courtesy of the Swedish Naval Attaché, Commander de Bahr, and the Commanding Officer of the ship, Captain J. A. F. Eklund. Accompanying the squadron was the Fylgia, an armoured cruiser launched in 1905, which now serves as a training ship. This vessel displaces nearly 5000 tons, and has triple-expansion engines developing 13,000 horse-power.



THE BATTLESHIP DROTTNING VICTORIA



THE BOW GUNS OF THE BATTLESHIP SVERIGE—LOOKING AFT

She reached 22.7 knots on trial. She is armed with eight 6in. 50-calibre guns, fourteen 6-pounders, and two submerged torpedo tubes. The water-line amidships is protected by 4in. armour. The remaining two units of the squadron were the sister destroyers, Wrangel and Wachtmeister, completed at Gothenburg in 1918. Displacement, 498 tons; speed, 34 knots; amament, four 14-pounders; and six 18in. torpedo tubes. These are handsome little ships, very British in appearance, and bear, like all the other vessels of the squadron, the stamp of sound design and skilful workmanship. Torpedoes can be discharged ahead, almost in line with the keel, from two tubes, mounted one each side below the forecastle deck, and firing through ports. The other four tubes are twin-mounted on the centre line aft. We were informed that both these destroyers have touched 35 knots when steaming at normal draught, with all equipment on board.

We venture, in conclusion, to suggest that an occasional visit to ships such as the Sverige and her consorts is of value, as it tends to correct one's sense of proportion, which is apt to become distorted by contemplating only the huge capital ships of major navies. Ships of the Sverige class would not, it is true, be of much value to the British Navy, but they, nevertheless, serve as an object lesson in the economy of weight, space and money, and show that under skilful direction very striking results can be achieved with limited resources.

NEW STEAM TURBINE DESIGN.

NEW features are embodied in two 5000-kilowatt turbo-generators built by the Allis-Chalmers Manufacturing Company for a municipal lighting plant. One improvement is a new method of baffling to reduce the leakage of steam around the ends of the blades. In the older construction the shroud gave as close radial clearance from the cylinder and spindle as was possible, whilst allowing for vibration, whipping of the shaft or distortion of the cylinder under high temperatures. In the new design there is large radial clearance, but small axial clearance, the lip of the shroud ring coming into close axial proximity with a lip cast in the blade foundation ring. An axial baffle to prevent steam leakage is formed by bending over the lip of the shroud ring. The clearance is only one-third or one-fourth of the usual radial clearance. In the high-pressure end the usual drum construction is replaced by a number of forged steel rings, each carrying only one or two rows of blades. In this way carbon steel may be used instead of alloy steel. The larger blading of the low-pressure end is made of Monel metal, as superior to the copper-nickel metal formerly used for blading subjected to high stress. Another improvement for economy is the elimination of the third or low-pressure balance piston. Any steam leaking past the balance piston at the high-pressure end is led by equalising pipes to the beginning of the third stage in the cylinder, in which it must do useful work before being discharged to the condenser. A thrust bearing takes the place of the low-pressure balance piston.

THE worst railway accident that has happened in New Zealand occurred early in the morning of Friday, the 6th inst. The Auckland to Wellington express ran into a landslide, and in the consequent wreck fourteen passengers were killed.

A Thames-side Motor Car Works.

SOMEWHERE about thirty years ago Thames Ditton was celebrated for the superlative workmanship put into the Willans engine, and the factory on the backwater just below Molesey Lock can, perhaps, lay claim to have been the birthplace of interchangeability in engineering manufacture, but when the Willans works migrated to Rugby Ditton lost most of its engineering activity. Within recent times, however, the old buildings have become more active than ever, have been supplemented by others on the opposite side of the road, and now some 800 hands find employment in the production of light motor cars that are, in their way, comparable as regards accuracy with the steam engines made there before.

GENERAL VIEW OF MACHINE SHOP

The works are, of course, occupied by A. C. Cars, Limited, and are now turning out the A. C. light car at the rate of forty per week, while it is expected that the output will be increased to forty-five per week very shortly. It is noteworthy, however, that the car is not made on the intensive mass-production lines that characterise some works.

At the first glance into the shops it does not appear that they are organised differently from any general engineering works, but there is, nevertheless, quite a definite scheme of progress. Thus, to some extent, the machines are grouped in classes and all the broaching machines are together, as are also the gear cutters—of the Fellowes type—but the general policy has been to divide up the shops into sections, in each of which a complete unit, ready for assembly in the car, is made.

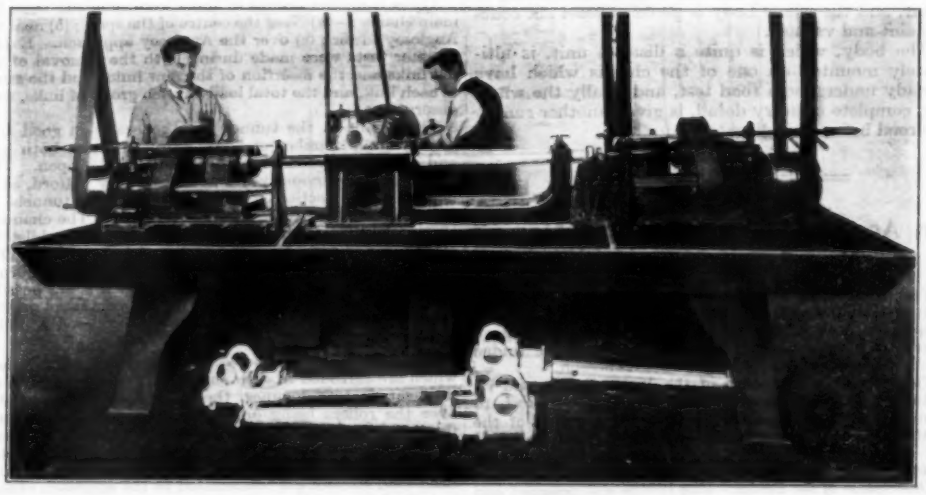
All the raw materials used in the works, such as bar stock, castings, forgings, and so forth, first go into a receiving store, where they are grouped and ticketted according to Air Board specifications. Important aluminium alloy castings are prick punched all over to test for porosity, while steel is tested by the Brinell method for hardness. In this connection we noticed, during a recent visit, that steel bars are painted with a distinctive colour throughout their length, not merely with a dab at one end, so that the character of a piece can be settled directly, however short it may be. In the store there are the usual cutting-off machines, while one of the weighbridges has been fitted up for testing springs.

The main springs for the car are of the quarter-elliptic type, and are bought outside. As soon as they are received they are clamped in a stout stanchion fixed alongside the weighbridge, and an ordinary jack standing on the platform is used to deflect them to a definite extent. The load applied is read off on the steelyard, and only those springs coming within strict limits are accepted by the store.

In the machine shops most of the machines are, as we have already suggested, of standard types, but we noticed several rather interesting single-purpose machines. One of these—which we illustrate—was employed on the torque tube that also forms the change-speed gear-box of the car. It should be explained, incidentally, that the gear-box bolts up against the differential casing of the back axle and thus all the gear is in a compact mass well away from the frame of the car, with the object of reducing perceptible vibration to a minimum. Both the torque tube and the back axle casing are aluminium alloy castings.

The gear-box end of the torque tube is passed through a preliminary operation in which a gang mill faces up the sides and top, after which the bolt holes are drilled in a jig. It is then taken to the special machine, just mentioned, into which it is clamped by bolts passing through the same holes that will be used when it is put into service. In this way it is assured that the casting is stressed in the machine in the same way that it will be when assembled. The machine has three separate headstocks, each driven by its own belt, which are equipped with rotary cutters. Two of the cutters are used to face up the opposite ends of the tube and bore out the seatings for the propeller shaft bearings, while the third cutter, which is set at right angles to the other two, machines up the facings for the back axle. The heads are fed forward to fixed stops by hand, and the operator has consequently to go from one head to the other to perform the three operations on the casting, but as the output can easily be kept up to requirements, there would be little advantage in adding automatic feeds for the headstocks. The cutters are supplied with a copious flow of paraffin, and produce a very good finish.

The larger parts that go to make up the back axle are viewed on the floor, while the smaller pieces are sent directly to the view room, where they are checked and the hardened parts are given a Brinell test.



MACHINING TORQUE TUBES

Accepted parts are sent into store, but rejected ones are set aside with a written explanation for their rejection, so that efforts may be made to prevent a recurrence of the trouble. An extensive system of gauging has been organised in connection with this department, and arrangements are made to ensure the return of the gauges at regular intervals, so that they may be compared with standards, among which there is a fine set of Johansson blocks.

Running right round the machine shop there is a wide gallery, which is used for assembling the back axle, or rather the unit which comprises the back axle, gear-box, torque tube, and road wheels. The various parts are added in a progressive manner, and finally the complete part arrives at the end of the gallery, where it is set up on a frame and connected by belt with an overhead shaft. It is run in this way for any length of time that may be necessary to eliminate any noise caused by the newness of the gear wheels, while an observer goes round the unit to see that it is all in order. The complete axles are then sent away to a separate stock room.

Two types of engines, one having four cylinders and the other six, are fitted in the A. C. cars. It is not our purpose to describe the engine here in any great detail, but it is sufficient to mention that the cylinders of the six-cylinder set have a cubic capacity of 2000 c.cm., and that the engine is rated at 16 horse-power, while the output actually is some 40 horse-power when running at full speed.

The trunk casting is of aluminium alloy, and into it are pressed the six steel cylinder liners, while a single iron casting forms the head for all the cylinders. This head casting is a very nice piece of work, and is cored out to form the inlet and exhaust ports for the overhead valves, while it also carries the bearings for the cam shaft and the valve rockers.

In order to make sure that the compression pressure in all the cylinders is identical, the compression spaces are finished in a machine—also illustrated—which looks very much like a horizontal boring mill with three spindles. The spindles carry big milling cutters which are shaped to the form of the compression space. The head casting is mounted in a jig and fed up to the cutters until it reaches a stop. It is then moved lengthways so that the cutters can operate on the remaining three spaces.

On account of the high speed at which the engine runs the crank shaft is balanced dynamically with great care, by mounting it on rollers supported by rubber cushions. The shaft is run up to speed by a belt drive, and if the supports show any tendency to wobble temporary weights are fixed on the cranks until a true balance is obtained. As, however, it would be unsafe to use screwed on balance weights, equilibrium is obtained by grinding off a corresponding amount of metal on the opposite side of the crank webs.

The same general policy is adopted with the engine as with the other parts we have mentioned. It is assembled in a distinct shop, and we observed that very little fitting is required in the process. In fact, practically the only manual work done on the parts is the bedding of the crank shaft. The white-metal bearings are reamered out in places and then scraped to match a long mandrel, while just a touch with a scraper is given to the bearings to provide side clearance, if it is found necessary when the crank shaft is tried in place.

A propos of the crank shaft we noticed an ingenious and effective method of preventing oil escaping where the shaft emerges from the crank case. A right-hand square thread, a few turns long, is cut on the shaft, and a corresponding left-hand thread is formed in the hole in the case. The threads naturally do not engage, but their tops very nearly touch. We were told that since this device was adopted all trouble with oil escaping has been eliminated.

When the engines have been completed they are sent to the ground floor, where they are given a running test. For this purpose there have been installed a Heenan and Froude dynamometer and a number of Walker fan brakes. Every engine made has to pass through this department, and must develop the requisite power before it is passed out to the store.

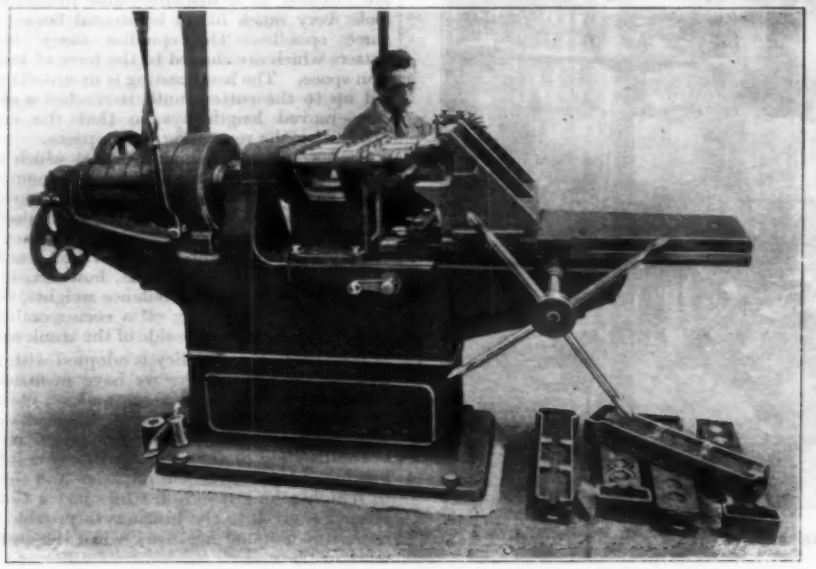
Apart from the engine and the back axle unit there are few intricate parts about the car, but each is, nevertheless, subject to the same procedure, and even such insignificant items as lamp brackets and exhaust pipes go through similar processes. Finally they are all assembled to form a complete chassis, and this is provided with a jury body, with which it is sent on to the road and given a run of about a hundred miles. If all is satisfactory the chassis is

run, on its return, into the shop where a proper body is fitted to it.

The body-making department is quite distinct from the mechanical engineering section of the works, and is on the opposite side of the road to the old Willans works. It has its own store for timber, of which only three varieties are used, viz., ash, mahogany and birch plywood. There are also stores for aluminium sheets, for panelling, leather, horse-hair, and so on.

The production of the woodwork for the bodies is carried on under much the same conditions as those in the engine machine shops. Models, or rather templates, of each individual part are prepared, and are painted with various colours to indicate to how many types of body each part is applicable. These templates are elaborated to the extent that they even show the positions of screw holes and the depth to which they need countersinking.

A large stock of timber is always kept in hand, so that it has an opportunity to season before it is converted, and after the various members of the body have been machined up they are put into stock for some time so that all fear of warping may be avoided.



MACHINING CYLINDER HEADS

In building up the body a number of jigs—perhaps the joiner would prefer to call them forms—are used, and after the several parts of the frame have been screwed together, the joints are bandaged with glued canvas, so that the whole structure is quite rigid. The panelling is generally of aluminium, which is bent to form, where necessary, under a planishing hammer that has a very deep gap, so that a whole panel can be made in one piece. When fixed in place the aluminium is given a coat of "dope" to prevent any interaction between it and the lead in the coating of paint, and the whole body is given at least six coats of paint and varnish.

The body, which is quite a distinct unit, is ultimately mounted on one of the chassis which have already undergone a road test, and finally the whole car, complete in every detail, is given another run on the road before it is dispatched for sale.

An Account of an Examination of the Menai Suspension Bridge.*

THE Minister of Transport having asked for a memorandum dealing with the question of the safety of the Menai Suspension Bridge, the Director-General of Roads gave instructions that a complete examination of the bridge should be made and a report submitted thereon.

The national importance of the Menai Bridge and its historical associations render it of special interest to members of the Institution; whilst the question of the methods to be adopted in investigating the suitability of old structures for modern conditions of traffic affords matter for serious consideration.

Description of the Bridge.—The bridge was designed and built by Thomas Telford in 1820–1826, and is still the only road connection between Anglesey and the mainland. The suspended span, which is 580ft. from centre to centre of the towers, is supported by four main chains, which divide the bridge into two roadways and a centre footway. Each of the four main chains consists of four lesser chains superimposed, and each single chain is composed of five long links and six short links alternately, the links being connected by 3in. diameter forged unturned pins. The platform is suspended from the chains by 1in. square rods hung vertically and attached to cross girders, which in turn carry the longitudinal trough flooring. The floor as now existing weighs about 320 tons more than the original floor.

* Official abstract of a paper by Mr. Henry Tudsbery Tudsbery, M. Inst. C.E., and Mr. Alec Robert Gibbs, Assoc. M. Inst. C.E., to be brought forward for discussion at the Institution of Civil Engineers.

Method of Examination.—The general procedure adopted in the examination of the bridge was as follows:—

(*a*) Collection of information available from drawings, &c.

(*b*) Verification of this information and collection of further information from the site.

(*c*) Theoretical calculations.

(*d*) Detailed examination of all parts of the bridge.

(*e*) Extensometer measurements of existing stresses.

(*f*) Tests to ascertain the stresses produced by live load and impact therefrom on the various members of the bridge.

(*g*) Physical tests to ascertain the nature and present condition of the wrought iron.

The bridge is built of forged members made up of welded wrought iron, which, therefore, vary considerably from the nominal sizes. It was consequently necessary to ascertain the minimum dimensions of the existing links in the main chains and the exact condition of the individual members of the bridge as regards corrosion, &c.

The choice of a suitable extensometer was not an easy matter. Although the examination had been delayed until the summer to get fair weather conditions, the wind sometimes attained a speed of 40 miles per hour. When arrangements had been made for the removal of the links or for the attendance of test loads, &c., it was imperative, for financial reasons, to proceed according to programme, and consequently necessary to have instruments which were capable of use under unfavourable conditions and in exposed positions. Permission was, therefore, obtained of the Minister to use a stress-indicator designed by one of the authors, which appeared likely to be suitable. This instrument proved equal to all the requirements; it was simple, could be used in a confined space, was not affected by a breeze, and in windy or stormy weather was easily protected by a tarpaulin hung on the windward side.

Three complete groups of links were removed from the main chains:—(*a*) Near the centre of the span; (*b*) near the Anglesey tower; (*c*) over the Anglesey approach. Extensometer tests were made during both the removal of the old links and the insertion of the new links, and the stress in each link, and the total load on each group of links, were observed.

The chains in the tunnel were generally in good condition, but a number of badly-corroded links, both long and short, were found in the chains in the open. This condition was obviously not anticipated by Telford, as he increased the section of the chains in the tunnels by 85 per cent. to allow for loss by corrosion. The chains in the tunnel have been painted by direct labour, whilst the chains in the open have been painted by contract. The authors are of the opinion that in this case the former method is the more satisfactory, but that it is not possible entirely to arrest corrosion of the nature existing in parts of the bridge, and painting can only be considered a palliative.

The saddles are supported by turned expansion rollers, which are corroded to such an extent that they do not act in a satisfactory manner, the movement of the saddles over the rollers being only a fraction of the calculated figure. The authors point out that the absence of means of preserving the rollers from corrosion was a weak spot in early designs. It was found from observations that the dead-load stresses are transmitted to the approach chains, but the failure of the rollers to operate prevents any live-load stresses from being carried to the chains over the approaches, and must consequently induce considerable stresses in the masonry towers. Observations with stress-indicators show that the stresses in a group of five bars forming one link may vary by 70 per cent., and are not uniform, as would be assumed in theoretical calculations. The authors consider that this is due to errors of workmanship in the forging of the pins, which were not turned. When new pins were inserted, a much better distribution of stress was obtained. Observations were made of the additional stress induced in the chain by the operation of removing and replacing links.

The live-load tests generally confirmed theoretical computations, the impact from traffic proceeding in accordance with the regulations—walking pace—or from a lorry bumping over a 2in. piece of timber being very small so far as the main chains were concerned. The authors summarise the stresses to which the main chains are subjected, and in this connection the following loads have been taken into account:—

(*a*) Dead load of structure.
(*b*) Live load coming on the bridge.
(*c*) Impact from live load striking obstructions—this has not been added to the total.

Loads rendered necessary by repairs to the bridge as follows:—

(*d*) Load induced by dead weight of stopper. (The stopper is the appliance used for holding the ends of the links of the chains while intervening links are removed and replaced.)

(*e*) Additional stress induced in chain, when the stopper is tightened up.

The following are the maximum recorded stresses, taking no account of stresses set up by wind, &c.

	Centre of bridge. Tons per sq. in.	Near Tower. Tons per sq. in.	Anglesey approach. Tons per sq. in.
(*a*)	7.2	8.18	8.58
(*b*)	0.73	0.63	nil
(*c*)	Not added	Not added	nil
Total (*a*) and (*b*)	7.93	8.81	8.58
(*d*)	0.30	0.30	0.30
(*e*)	1.36	1.50	1.43
Total	9.59	10.61	10.31

The recorded stresses show some variation from those calculated, as they show the effect of stresses induced by irregularities of workmanship, such as unturned pins, irregular lengths of links, &c., also the possibility that the load is not evenly divided between the four chains forming one main chain.

The stresses in the bridge are unusually high, and the factor of safety to be considered a minimum is a debatable point. The usual factor of safety for a structure of this nature, ignoring wind-stresses, would be one-fourth of the ultimate stress or one-half of the elastic limit. Under the actual conditions it is found that in places the wrought iron is at times stressed to its elastic limit. It has to be remembered that the members of the bridge are made up throughout of welded parts, the individual bars which form the long or short lengths of the main chains having been made of piled rods; the eyes also were forged separately and then welded to the shanks. The suspenders were similarly welded.

Tests made at the National Physical Laboratory on links removed from the main chains gave a yield stress of 13.6 to 16.2 tons per square inch and breaking loads of 19.8 to 24.5 tons per square inch. The tests made to ascertain the limit of proportionality gave a mean of 10 tons per square inch. The more important results of tests carried out by the National Physical Laboratory on eleven long links removed from the bridge are given in an appendix to the paper, with certain collated results of tests carried out on the site.

There are 796 suspenders or vertical ties in the bridge, and each of these comprises from two to six lengths. Those over the approaches only serve the purpose of maintaining the chain in the desired curve. These bars nevertheless carry a load approximately equal to the dead load in similar ties on the suspended span and, therefore, cannot be ignored.

In 1908 considerable renewal work to the bridge was carried out, the renewal of vertical ties being an important part of this work. No seriously corroded bars, therefore, were discovered on the present examination; and, where a bar was noticeably corroded, it was found to have been originally of larger size than normal. In all cases these corroded bars are situated in the approaches and are not liable to live load, but they are, of course, liable to variation in stress due to wind-pressure.

Experience with stress-indicators on the suspension rods illustrated how difficult it was to estimate the load they were carrying by vibrating them. There is considerable variation in the tautness of the rods, and they might with advantage be adjusted by means of instruments similar to those used during the examination.

When the stress-indicator was in use on these bars during July it showed on many occasions an increase of stress of about 1 ton per square inch due to the wind. In considering the calculated loads coming on these rods, the vibration due to wind has to be taken into account.

Although exact details as to the quantity of traffic passing over the bridge are not available, it may be taken that approximately 2000 tons passes over the bridge daily during the summer months.

Chinese Engineering Notes.

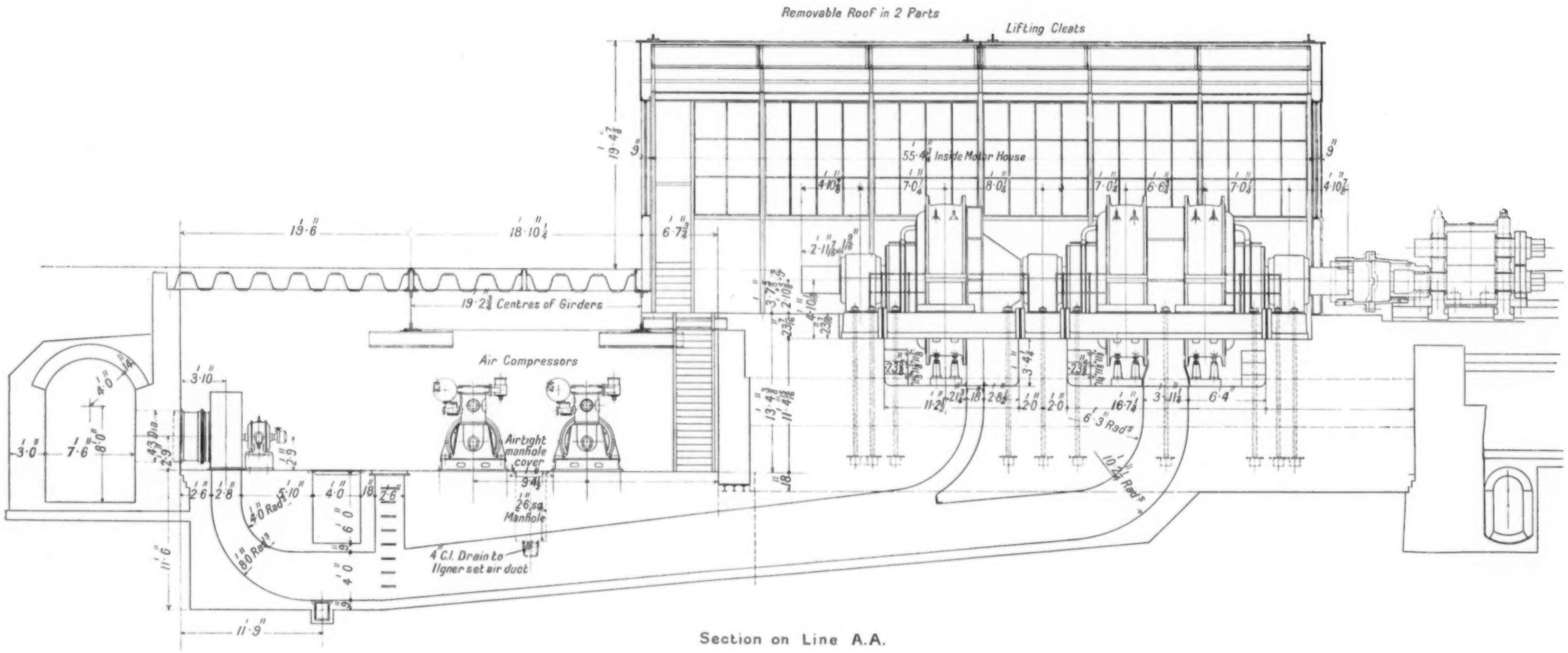
(*From our own Correspondent.*)

PEKING, June 12th.

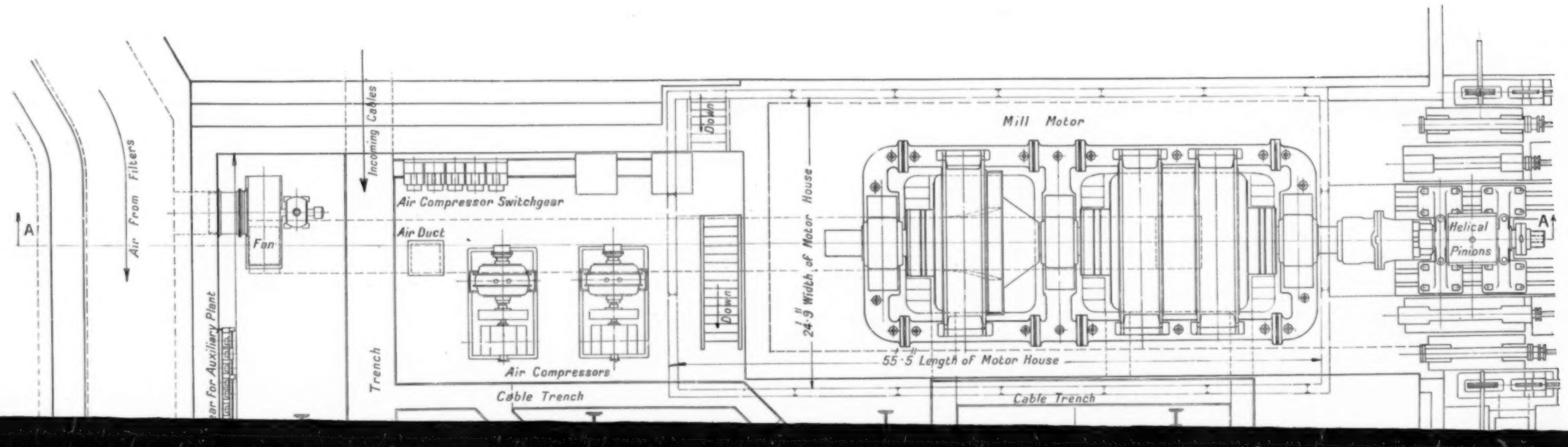
PREVIOUS reference has been made to the violation by certain nationals of the arms embargo in China, and although the Legations here of the people concerned always deny knowledge of their nationals importing arms into China, it is a fact that this traffic is going on all the time, and it may be safely said that the British are the only people who have consistently respected the agreement. This position is very galling to representatives in this country of British armament firms, and it must be equally annoying to the firms at home. Aeroplanes are supposed to be included in the embargo, and the British Government through its Legation here has definitely refused to allow its nationals to sell any kind of aircraft equipment in China, either to the Government or private individuals. Nevertheless, some half-dozen American—Curtiss—machines were imported into China a few months ago with the permission of the American Government, on the grounds that the machines were sold to a Chinese individual for commercial purposes only. The machines were originally destined for the Province of Fukien, but when they arrived in Shanghai, fighting was going on in Fukien, so the Chinese individual who had bought them took them to Hankow, knowing that if they went to Fukien the military authorities would immediately seize them. Complications then arose, as the American Govern-

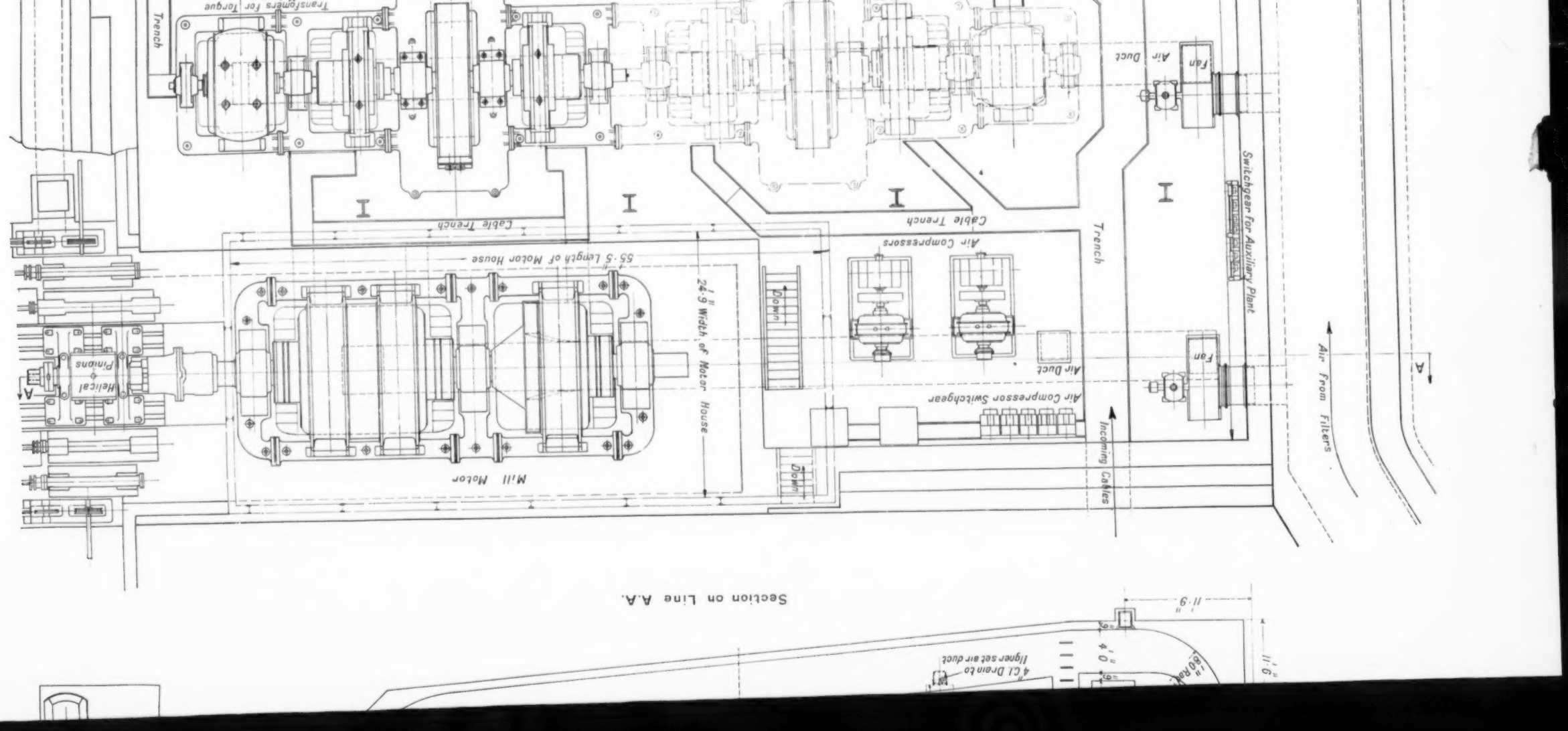
THE PENISTONE WORKS OF CAMMELL LAIRD AND COMPANY, LIMITED

ELECTRICAL EQUIPMENT OF 19,000-B.H.P. MILL MOTOR

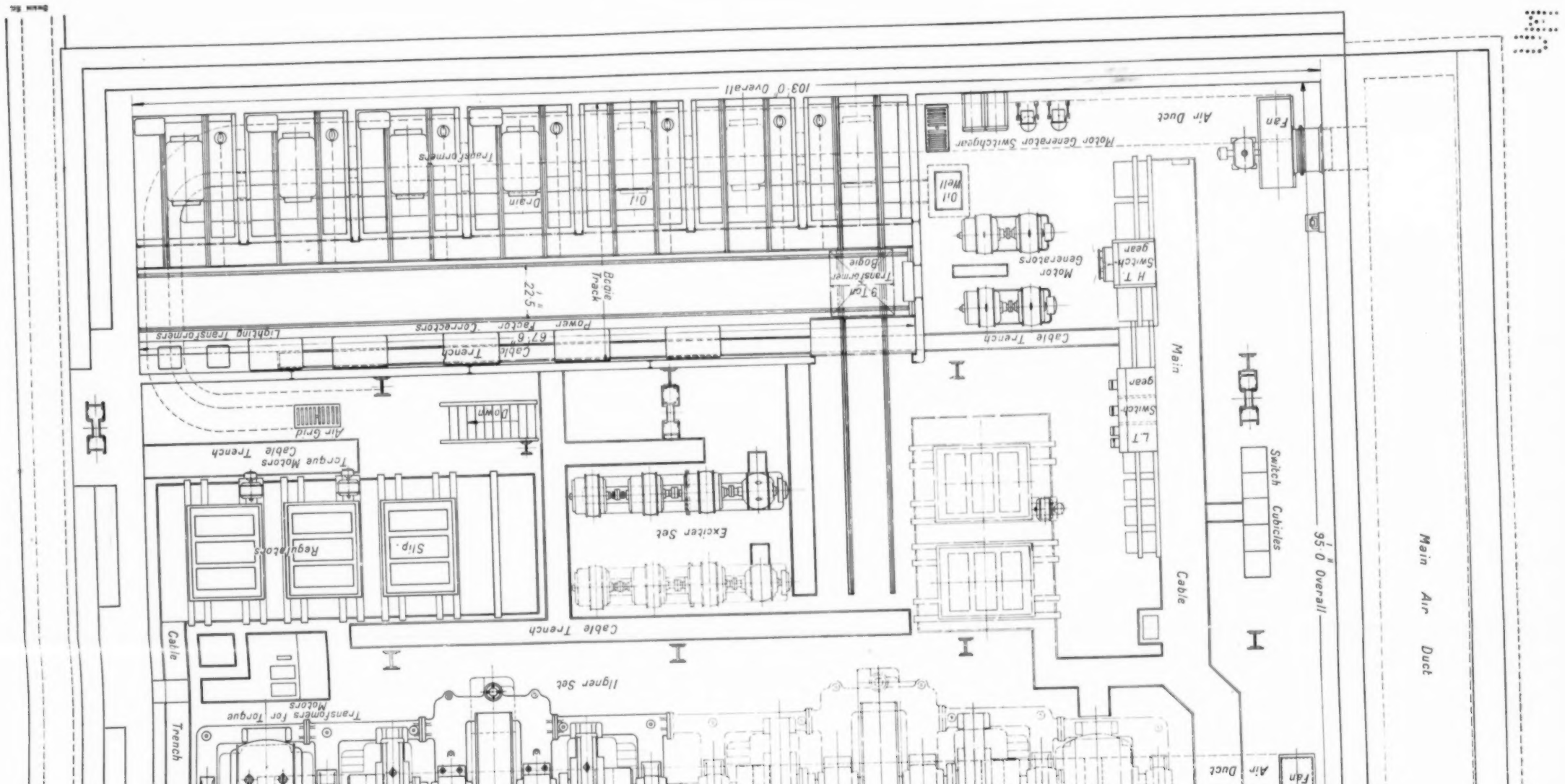


Section on Line A.A.





Section on Line A.A.


Down
Air Grid
Torque Motors Cable Trench
Regulators
Slip
Exciter Set
Cable Trench
Cable Trench
Transformers for Torque Motors
Ilgner Set
Cable Trench
Power Factor Correctors
Lighting Transformers
Cable Trench
Brake Track
225'
Drain
Oil
Transformers
103' 0" Overall
Motor Generator Switchgear
Air Duct
Fan
Oil well
Motor Generators
H T Switch gear
Transformer Bogie
Car
Cable Trench
Main
L T Switch gear
Switch Cubicles
95' 0" Overall
Cable
Main Air Duct
Air Duct
Fan

ment took the view that as permission had been granted for the machines to be delivered in Fukien, the importers had no right to divert them to Hankow, where they would also be likely to fall into the hands of the military. Eventually the machines were shipped to Tientsin, and it is the intention of the Chinese who purchased them to run an air service between Tientsin and Peking. Information has recently reached Peking that nationals of one of the signatories to the Arms Embargo Agreement have imported large quantities of arms and munitions of war into one of the southern provinces, and if this proves to be true, it will be time for the British Government to change its attitude towards the terms of this agreement. Such an agreement can never be made effective in China, and it seems a pity that the British should be the only people to suffer because they respect it.

Practically all the rails and permanent way equipment for the Peking tramways have arrived in Peking, and construction work has now begun. Rolling stock and overhead equipment will be shipped shortly, and it is hoped to have the first section of the trams running within one year. Tenders will shortly be called for in Tientsin for a new bridge across the Pei River. At present there is only one bridge connecting the concessions on the south side of the river with those on the north side.

The Mukden authorities are obtaining prices for two 1000-kilowatt turbo-generators and five or six boilers. It is believed this equipment is required for the new arsenal which is being erected in that city. In spite of the difficulties the Germans are having in Europe, they are making desperate efforts to obtain these contracts, and making wild promises as to delivery. Some months ago the Germans obtained a contract from the Mukden Government for the supply of various parts necessary to put the Harbin wireless station in order, but there is still no sign of their making delivery. The wireless station at Harbin formerly belonged to Russia, and is of the Telefunken type. Four years ago the Chinese Government purchased 200 portable wireless telephone and telegraph sets of the Y.C. 1 type from the Marconi Company. During the various revolutions that have taken place round Peking since then, nearly one-half of these sets has been captured by the provincial authorities. About twenty-five of them are now in the hands of General Chang Tso Lin, in Manchuria, and it is interesting to hear that although the Marconi Company only guaranteed a transmitting range of 70 miles, General Chang's wireless experts are getting a constant range of 250 to 300 miles.

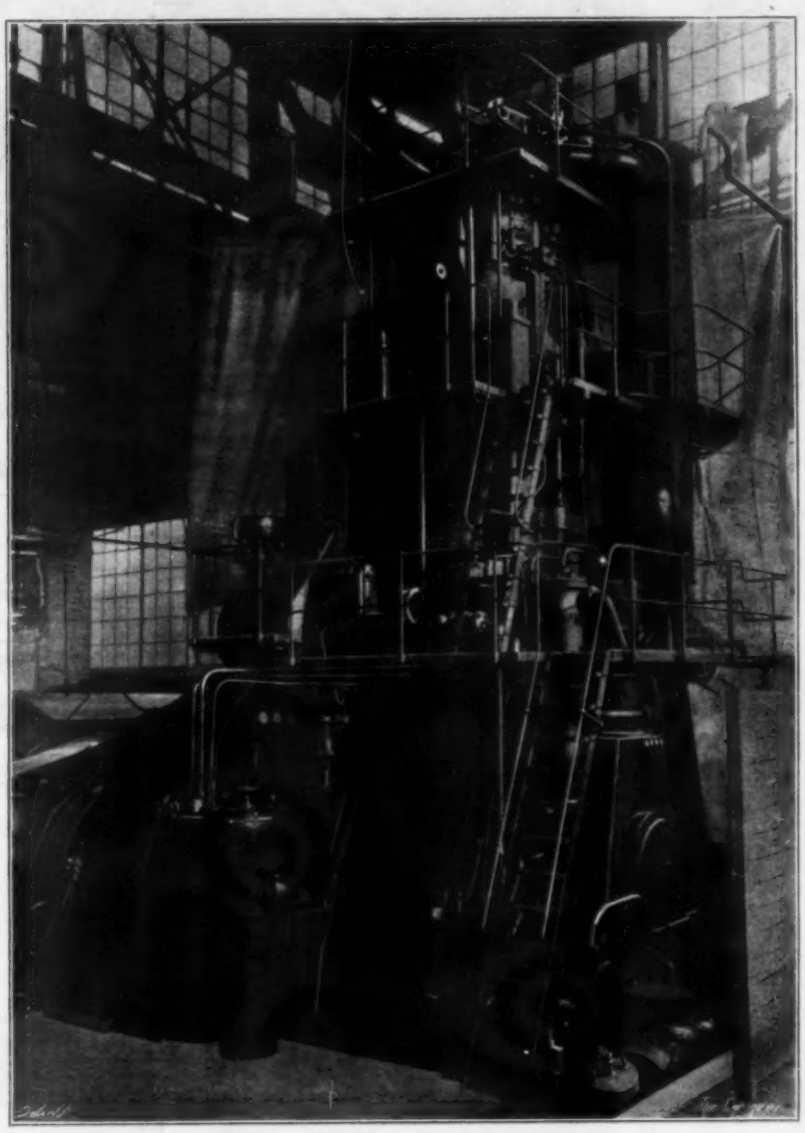
Trade throughout China has suffered a serious setback as a result of the present political upheaval. There is no Government in Peking, and serious trouble is expected at any moment. Conditions in the interior of the country are very disturbed, as a result of the large number of bandits at large. Such conditions have an immediate effect upon both import and export trade, and machinery business particularly suffers. In spite of unfavourable conditions last summer in North China, the machinery branch of the import trade held its own, according to the Customs report for 1922. Importation of textile machinery did not repeat the phenomenal advance of 1921, but that was an abnormal year, as the importation of this class of machinery increased from nearly 10 million taels in 1920 to nearly 27 million taels in 1921. In 1922 the importation of machinery for textile industries was valued at 30.5 million taels. Of this total, more than half came from Great Britain, one-fifth each from America and Japan, and the balance from Canada. The increase in the last few years in importation of electrical materials did not continue at the same rate in 1922. This is explained in the Custom's report as being due to general depression of trade and to the drop in exchange, which no doubt affected all engineering business in China.

SIXTY YEARS AGO.

SOME interesting views on the composition of steel were expressed in an article which we reprinted from the *Mining Journal* in our issue of July 17th, 1863. Some French metallurgists, notably M. Fremy, were at that date strongly of the opinion that nitrogen, either by itself or in the form of cyanogen, was an invariable and essential constituent of iron and steel, and that its amount exercised an important influence on the quality of the metal. Other French metallurgists, such as M. Caron, declared, however, that if nitrogen were present in steel it was so not essentially but by accident, and that its amount was too infinitesimal to exercise any effect on the properties of the material. It would appear that by examining the residue left when iron or steel was dissolved in acids indications of the presence of nitrogen amounting to anything from one part in 555 to one part in 500,000 had been obtained. While the *Mining Journal's* article refrained from completely discrediting Fremy's suggestion, it adduced strong experimental evidence which pointed to the belief that the nitrogen found in the residue was not derived from the iron but was present as a result of absorption from the air. It does not appear to have suggested itself to anyone that it might be present as a result of impurities in the dissolving acids. . . . In a leading article we discussed the origin of the screw propeller. After mentioning Watts' idea for a "spiral oar," we gave details of Richard Trevithick's invention, patented in 1815, the specification of which "described the screw propeller with considerable minuteness," and remarked that his allusion to the vanes of a smoke jack seemed to show that he had hit upon the principle of the short screw. Wilson, Nasmyth's partner at the Bridgewater Foundry, was next mentioned. His short two-bladed propeller, "nearly identical in form with many good propellers now in use," reached, it seems, a highly developed stage, and was very favourably reported upon by a Committee of the Royal Scottish Society of Arts. It was, however, rejected by the Government in 1827 and condemned *in toto* in 1833. After examining the claims made by Steadman and McCririck, Andrew Smith, Captain Carpenter, Ericsson, Woodcroft, Lowe and Blaxland, we expressed the opinion, without hesitation, that Mr. F. P. Smith deserved the credit for having introduced the screw propeller into use. Smith first experimented with the propeller in 1836, and it was he who a year later discovered the virtue of the short blade as the result of an accidental breakage. With the co-operation of Messrs. Rennie, the engineers, and Messrs. Wright, the bankers, he fitted screws to the Archimedes in 1839 and to the Rattler in 1843. Smith's credit is to-day undiminished. Wilson's experiments appear to have been forgotten.

1000-H.P. SINGLE-CYLINDER DIESEL ENGINE

BURMEISTER AND WAIN, COPENHAGEN, ENGINEERS



Double-acting Four-cycle Engine.

IN a Journal note of March 23rd we were able to announce that the Swedish-America Line—the managing director of which is Mr. Dan Brostrom, of Gothenburg—had placed with Sir W. G. Armstrong, Whitworth and Co., Limited, an order for a large ocean-going twin-screw passenger vessel in which Diesel engines of an entirely new type are to be installed. The order for the machinery was secured by Burmeister and Wain, of Copenhagen, as the direct outcome of experimental work which had been in hand for more than two years, with the result that a new type of marine Diesel engine working on the double-acting four-cycle principle has been evolved.

We illustrate above a single-cylinder unit designed to develop 1000 brake horse-power, taken in the company's experimental shops at Christianhavn, where it has been in operation for four months. During this time the trials made included, we learn, a non-stop run of about one month's duration, which was made with very satisfactory results. Up till lately the largest size of Burmeister and Wain engine which had been built had developed about 300 brake horse-power per cylinder. Such engines have mainly been used in the form of eight-cylinder units in a twin-screw machinery arrangement for combined passenger and cargo vessels of from 13,000 to 14,000 tons deadweight capacity, a total of about 4800 brake horse-power being developed.

The new double-acting engine opens a new field for the use of the marine oil engine, in that it makes possible the large high-speed motor liner, and the makers believe that the saving in fuel costs which has been proved in the case of medium-sized ships may now be looked for in the largest liners.

We are given to understand that for the largest powers the double-acting engine will generally be installed as twin-screw machinery and will conform to existing steam reciprocating and turbine practice in that respect, thereby avoiding the introduction of extra shafts and propellers. For medium and smaller vessels the engine will also be developed as a long-stroke engine for single-screw ships, and for that work it may be built in sizes of 5000 to 6000 brake horse-power. It is expected that this arrangement will partially supersede the present system of twin-screw machinery. In the new motor liner for the Swedish-America Line twin-screw machinery will be adopted, the propelling engines comprising two main six-cylinder units having a total output of 13,500 brake horse-power and giving a sea speed of 17 knots under service conditions. For operating pumps and providing power and lighting six auxiliary Diesel generating sets having a combined rating of 3150 brake horse-power will be installed. The complete machinery is to be built by Burmeister and Wain at Copenhagen, and will be put aboard the vessel at Armstrong and Whitworth's Tyne yard. It is hoped that the new liner will be ready for service in about eighteen months' time.

COPPER IN THE UNITED STATES.

A GREAT increase in the use of copper for miscellaneous purposes has resulted from the comparatively low price and the extensive publicity campaign of the Copper and Brass Research Association. Copper roofing, tanks, gutters, &c., are being used extensively in the building trades, as well as brass for plumbing pipe. Most of the copper is used for such fabricated products as wire, sheets, rods and tubes, but a large amount goes into alloys and into chemicals. About 60 to 65 per cent. of the virgin copper sold is cast into bars for wire; 15 to 20 per cent. for ingots and ingot bars, to be remelted for castings and alloys; 10 to 15 per cent. for slabs to be rolled into sheets and strips; 3 per cent. as cathodes, for remelting; 3 per cent. in special shapes, such as billets and anodes, and 3 per cent. as Bessemer, blister or converter copper in rough pigs of about 300 lb., largely used abroad in the manufacture of blue vitriol. A consumption of about 300,000 to 400,000 tons of virgin copper per year increased rapidly during the war period, reaching about 800,000 tons in 1918, while for 1922 the figure was 550,000 tons. More than half of the copper used is used for electrical apparatus; electrical manufactures, 30 per cent.; wire and rods not otherwise included, 16; telephones and telegraphs, 8½; automobiles, 8½; ships, 7; bearings and bushings, 6½; buildings, 6; machine fittings, 2½; railways, 2½; ammunition, 2; and coinage, only 0.3 per cent.

DIESEL-ENGINED FERRY BOAT FOR MOTOR CARS

YARROWS, LIMITED, VICTORIA, BRITISH COLUMBIA, BUILDERS AND ENGINEERS

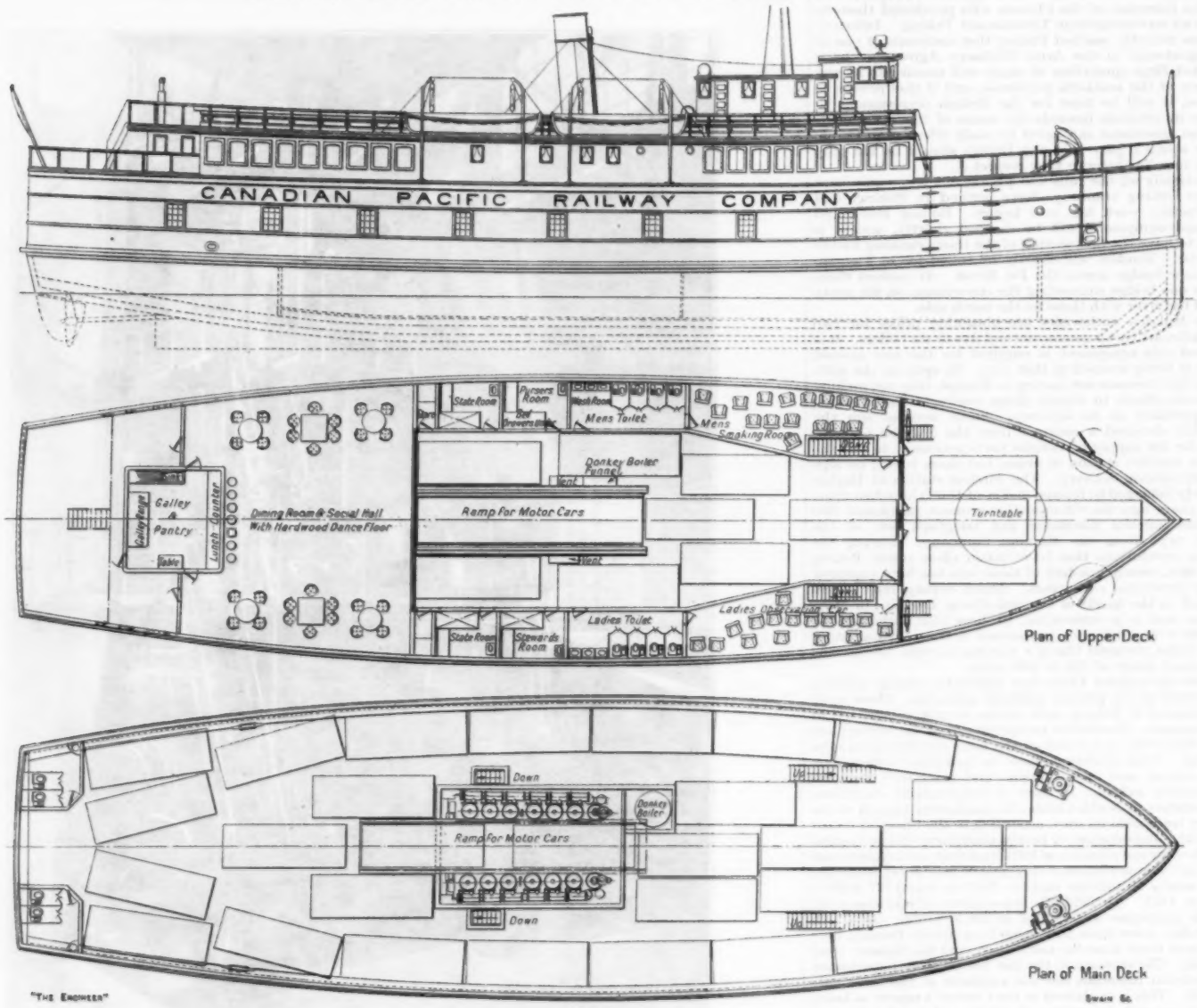


FIG. 1

A Canadian Motor Car Ferry.

TOWARDS the end of March last there was completed at the Esquimalt shipbuilding and ship repairing yard of Yarrows, Limited, at Victoria, British Columbia, an interesting Diesel-driven motor car ferry, the Motor Princess, which has been built to the order of the Canadian Pacific Railway.

With the improvement of the highways, particularly the Pacific highway, there has followed a steady increase in the motor and tourist traffic to and from Vancouver Island. In order to meet these demands the company, in October last, decided to provide a ferry specially built for the handling of motor cars and their occupants, which will operate between Sidney, Vancouver Island, on the Canadian side and Bellingham, Wishington, on the American side.

The idea of the new ferry was conceived by Captain J. W. Troup, the manager of the British Columbian Coast steamship service of the Canadian Pacific Railway, who, with his staff, co-operated with the builders, Yarrows, Limited, in getting out the plans of the vessel. It was decided to propel the ferry by twin-screw Diesel engines, and the ship is the first Diesel-engined craft in the whole of the Canadian Pacific organisation.

In approaching the problem, speed and carrying capacity were the two points to which the owners attached special importance. They presented some little difficulty in the initial stages of the design, as the former required high propelling power and the latter necessitated considerable beam. After the maximum carrying capacity had been fixed by the owners, the minimum beam was determined, and with a stipulated speed of from 13 to 14 knots the question then arose as to the most efficient lines to meet the requirements with the expenditure of minimum power and with maximum economy. The problem was solved by a series of model tests, which were carried out at the William Froude Tank of the National Physical Laboratory at Teddington.

The general lines of the new ferry and her deck and machinery arrangements will be seen from the drawings we reproduce in the accompanying illustrations, Figs. 1 and 2. The principal dimensions are :—Length, 170ft.; breadth at main deck, 42ft.; depth, 11ft. The hull is of wooden construction and has a bottom cross-section of the form shown in Fig. 2 to give high stability. Room is provided for forty-five motor cars, the space set apart for this purpose being indicated by rectangular markings on the upper and main deck plans. In general appearance the vessel resembles an ordinary steamship, such as would be employed on daylight passenger service, and bears small resemblance to the usual form of motor car ferry.

A novel feature of the ship is the arrangement for carrying cars on the upper deck as well as on the main deck. A ramp is provided between these two decks, which will enable motor cars to climb under their own power from one to the other, thus giving additional convenience in loading and discharging. Fig. 3 shows the main deck looking forward. On each side of the centre ramp are placed the two engine silencers. Such an arrangement obviates the slow and sometimes unreliable use of a lift, and also does away with the necessity for unsightly and often cumbersome posts and platforms. Captain Troup, who has had a great deal of successful experience in the designing and operating of passenger and other steamers plying in British Columbian waters, has given special attention to the general lay-out of the vessel

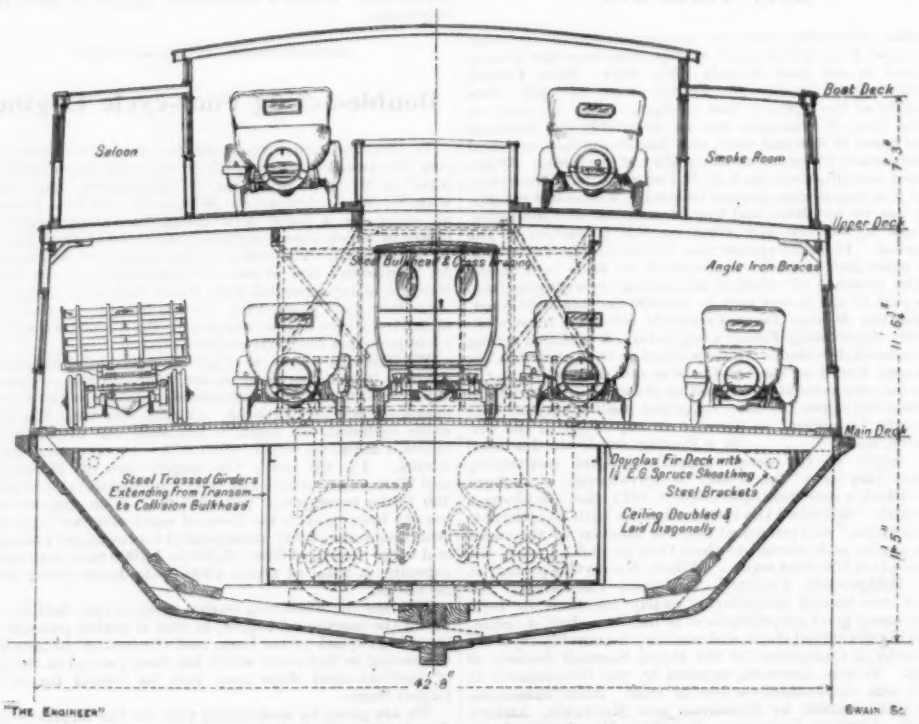


FIG. 2—CROSS SECTION OF THE FERRY BOAT

with a view to making the ferry as attractive, safe, and comfortable for travellers as possible. In addition to the arrangements which enable a large number of motor cars to be quickly loaded and discharged without delay or confusion, reference may be made to the comfortable and well-appointed accommodation of the public rooms. They are provided with large observation windows, and the dining saloon is furnished with a maple wood dance floor. The vessel is fitted with electric lighting and hot and cold water and heating services, special attention being given to the prevention of fire by the installation of appropriate fire-extinguishing apparatus.

The main propelling machinery comprises two sets of six-cylinder four-stroke cycle 600 brake horse-power McIntosh and Seymour marine type Diesel engines, which are designed to give a service speed of about 14 knots. On the trial run a speed of 14½ knots was obtained, and the new ferry is one of the fastest Diesel-engined vessels on the Pacific Coast.

The shipyard of Yarrows, Limited, the builders, is very well equipped for the construction of vessels of this and much larger types in steel and wood, and the work was carried through in fast time. The hull was launched early in March, and the whole work was finished in the short space of ninety-seven working days.

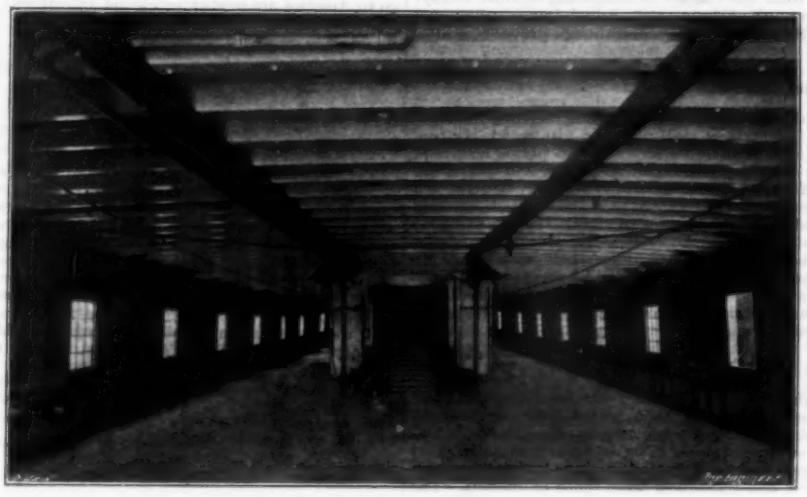


FIG. 3—VIEW OF MAIN DECK LOOKING FORWARD

TICKET MACHINES IN RAILWAY STATIONS.

IN booking halls of restricted size, it is of great importance that quick booking facilities should be provided. It may be impracticable to add to the size of the booking offices, but ticket machines overcome the difficulty, and the public appears, so we are informed, to appreciate this method of getting tickets.

With a view to accelerating the booking of passengers during the rush hours at Victoria Station (District Railway) the London Underground Company a short time ago placed a battery of twelve ticket machines in the circulating area as an auxiliary to the usual booking office facilities. These machines are now issuing tickets at the rate of 2,500,000 per annum, or approximately 30 per cent. of the total bookings at this station. The success of the scheme at Victoria has led to the establishment of similar batteries at Waterloo, Elephant, Bank and Mansion House, and a further batch of fifty now on order will provide the same facilities at Westminster, Paddington, Liverpool-street and Leicester-square in the near future.

Consideration is being given to equipping a warning bell to be rung in the booking office when the stocks of tickets are running low. An electrical device now fitted causes the machines to reject passengers' money if they are out of order. An interesting feature in connection with the Victoria Station batteries will shortly be introduced when the metal front of one of the machines will be replaced by plate glass, thus revealing to the passenger the clever mechanism of these electric machines, and enabling him to watch the progress of his coin from the moment of inserting it into the slot until the delivery of the ticket.

Whilst these improvements are being made, the rate of ticket issues from the booking offices has also been speeded up by the provision of Rolltic and Automaticket machines, of which fifty-one have now been installed at the busiest traffic centres. Recent rush period tests have shown that both types of machines have an output of well over 1000 tickets an hour, this including the giving of change. In both machines the tickets are kept in rolls of 1000, which are easily replaced.

NEW LIFEBOAT AND LAUNCHING SLIP AT CROMER.

THE ceremony which will take place at Cromer Pier at 3 p.m. on the 26th inst. will be a red-letter day in the annals of the Cromer lifeboat, for it will witness the dedication of the new motor lifeboat, the H. F. Bailey, which was built from a legacy left by a testator of that name, who placed a large sum for benevolent purposes in the hands of his friend and executor, Mr. C. F. Denny. It is not merely that Cromer has now been provided with one of the finest lifeboats which the progress of science and the development of the petrol engine has suggested. That, in itself, means an enormous increase to the efficiency of the station and its power of saving life from shipwreck; but the Institution, in its desire to make this prominent spot on our Norfolk coast as complete and perfect a lifeboat station as any in the kingdom, decided to make an experiment which has never hitherto been attempted.

Realising the advantage of being able to launch this heavy but powerful boat at any state of the tide, and away from all danger of rocks or groynes, the Committee decided to place both boat-house and slipway at the very end of the Cromer Pier, which itself runs out to over 400ft. from the shore. The difficulties and the cost of carrying out this experiment have, unfortunately, been high; but the result is that Cromer will possess a lifeboat house and slipway unique on our coast, and it is hoped that the equipment of the station in this manner will enable the crew of the Cromer boat to add still further laurels to a record of which it has every reason to be proud.

This is, perhaps, not the place to refer in any detail to the magnificent services of the boat during the war. But Cromer residents will not need to be reminded of the courage and dogged tenacity which characterised the services to the Pyrin and the Fernebo on January 9th, 1917, nor many another service which has contributed to make a record of over 257 lives saved. What is, unfortunately, so easily forgotten is that every penny of the large expenditure which the Institution is incurring is provided by voluntary contributions alone. There is not a penny from the State, and it should be a matter of pride to the inhabitants of these islands to maintain, in full scope and efficiency, the fine service which has made the British lifeboatman a model for the world, and which brings inquirers from every country in the world with a seaboard to ask the Institution to show them the way to run a lifeboat service.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation Unchanged.

THE opening of the third quarter has brought no change in the conditions existing on the Birmingham market, and the quarterly meeting last week has passed by, leaving it as depressed as ever. The outlook is so dubious that buyers continue to confine themselves to the satisfaction of immediate needs; indeed, there is no keen desire on the part of either producer or consumer to enter into forward business. Consumers are persuaded that the re-settlement of values on a lower basis is indispensable to any lasting revival, whatever comes of the efforts which are being made to solve political problems. Prices are precarious, as consumers continue to press for still further concessions. In some directions, notably in the case of steel, values are distinctly lower, but in many cases the extent of the fall is hidden behind quotations which have official sanction, but which are no longer in accord with the facts. The number of small contracts has somewhat increased, but the orders are so small when compared with normal conditions that it costs more relatively to handle a diminished volume of business. Certain users have, however, exhausted their stocks, and are obliged to renew. Iron and steel masters are now awaiting the autumn.

Decline in Steel Values.

Steel prices continue to fall, and the quotations nominally ruling are not being maintained in many branches. High carbon billets are down 10s. per ton, the Association figure now being £10 to £10 5s. Soft billets continue to command £8. While some Belgian houses quote £7 15s., others ask £8, the same as home makers, and this has helped to check the slump in native prices. Even in the case of the lowest foreign quotation, the difference in price is so slight as to make the advantage in favour of foreign steel too trifling to attract business. Some of the steel works are not suffering so severely as the other side of the ferrous trade. If they would keep plants active, they must meet customers with regard to prices, however. Underselling is extremely rife. Structural material is offered on lower terms. Business is reported in ship, bridge and tank plates at £10 5s., or 10s. less than recent quotations. Small bars can be bought at £9 15s. to £10, which represents a substantial reduction. For joists, which are quoted £10, 5s. less would not be refused by some makers. It is expected that the Staffordshire price for sections will be brought into line with readjustments in other directions. Ferro-concrete bars have been reduced to £11 delivered in this district, and steel strip from 18 to 20 gauge is lower at £12 10s. Considerable contracts are reported as being executed by Birmingham merchants with Belgian finished steel shipped direct from Antwerp to the customer at practically the same price as that charged for billets sold to this country. A little more business is being done in steel scrap. This market has shown slightly more firmness lately, and it is believed that a business basis has been reached. It is interesting to observe that recent figures show the output of steel ingots and castings for the kingdom as a whole for the month of June to be 767,700 tons, compared with 821,000 tons in May, and 400,200 tons in June last year.

Finished Iron Prices.

The finished iron trade of Staffordshire continues very unsatisfactory. Demand is languid, but there is not an absolute dearth of business. Much plant is idle and the opportunity is being taken to repair furnaces and renew plant in the expectation of greater activity in the autumn. For the most part, bar prices show little change. The slackness of the nut and bolt trade has robbed the market of support from this quarter, only occasional orders for special qualities and sizes being sent to the local bar mills. As a matter of fact, nut and bolt manufacturers are buying nothing at home that they can get from the foreigner, whose prices are roughly £2 a ton below those ruling in Staffordshire and Lancashire. Belgian shippers are now able to make good deliveries. They are stiffening their prices, and they find it no easy matter to get new business. Consumers are satisfied to carry on with the material they have already bought and to take their chance as to the course of the market. Local mills now quote £11 for nut and bolt bars. The price of Crown bars is now generally within the neighbourhood of £12, but some makers are still able to command 5s. or 10s. more. Merchant qualities are obtainable at £11 15s. Marked bars are unaltered at £14 10s. There is considerable disparity between prices quoted by different sellers for iron gas tube strip, but on the whole values are easier, and it is possible to buy this material from most quarters at £12 10s., a figure 5s. per ton below last week's minimum.

Cheaper Sheet Iron.

Galvanised sheets are a steadily weakening market, the present quotation being £17 15s. to £18 for corrugated sheets of 24 w.g. The mills have a fair reserve of orders, but are becoming concerned about their autumn business. There has been a considerable falling off in the overseas demand, and this has left the market very weak. Up to recently there had been a good demand for thin gauges for roofing under the new building ordinances of Japan. It will be a very long time before the demand is overtaken, so that the present intermission is thought to be a move to bring prices down. If that be the object, it has so far succeeded that 30 gauge sheets are now quoted £23 against the £25 ruling before.

Pig Iron Situation.

The pig iron market continues to weaken, and there is a marked disparity in the figures quoted. Forge qualities are not wanted, and there is only a very limited inquiry for foundry numbers. Smelters find it difficult to make concessions with fuel costs so high, but they are being compelled to yield ground. Derbyshire makes of foundry iron can be got at £5 at the furnaces, and for Northamptonshire No. 3 business is being done at £4 17s. 6d. The lower-grade North Staffordshire foundry is being sold at £5. These figures are not the rock bottom, however. In the South Staffordshire area well-known furnaces continue idle, as they have been for the last two years, through inability to make pig iron on a profitable basis. So far, production has not been further curtailed in this area, though some stocking of iron has taken place. With prices weakening, smelters must needs be on their guard against over-burdening themselves with stocks, and unless demand increases, action for the curtailment of output will have to be taken. Such orders as there are about at present are very small, hand-to-mouth buying being the characteristic of the market. Fortunately, as the result of the recent conference between ironmakers and coke makers, the price of furnace coke has been reduced 4s., the new figure being 26s. per ton at the furnaces. But the coke position continues uncertain in view of renewed buying from the Continent. Furnace owners hope if they can carry on over the next month, the autumn demand may infuse some life into the market, but the prospect of having to put iron into stock meanwhile causes some misgiving. Smelters hereabouts were somewhat surprised to find that the output of iron last month did not show a greater falling off than was actually the case. They had expected, with the decline of export demand, much less satisfactory figures than those recently published, which showed that the production for the country as a whole in June amounted to 692,900 tons, compared with 714,200 tons in May, and 369,200 in June, 1922. It is interesting that the number of furnaces in blast at the end of the month numbered 222, four having been blown in and five having gone out of blast during the month.

Cheaper Rolls.

Heavy iron founders have reduced the price of rolls, grain and chilled rolls being cheaper by £1 per ton. The foundries are not well off for work, the reduced activity at the mills involving less demand for plant renewals.

Coal Trade Armistice.

The armistice in the coal mining industry is regarded by industrialists hereabouts as satisfactory, inasmuch as it assures at least a further period of peace in this important department. That the miners in this part of the coalfields are in favour of present arrangements is shown by the fact that both Yorkshire and the Midlands, including Notts. and Derbyshire, were against ending the

agreement, though they expressed the opinion that it should be improved in their favour. It is obvious that a formidable controversy is merely deferred, but it will be some time before the Miners' Executive is in a position to report as to the result of its negotiations for the improvement of certain clauses of the present agreement. Most of the colliery owners, it is thought, regard the suggested alterations as tantamount to a proposal to destroy the agreement altogether. There can be no doubt but that the Miners' Federation will find it very difficult to convince the employers that the largely preponderating share they already take of the profits of the industry ought to be further increased.

Coventry and Aircraft.

Considerable interest has been aroused in industrial circles in Coventry by several important developments which are taking place. The aircraft industry, in which the city played an important part during the war, is expected to show a marked revival as the result of the establishment of a reserve flying school at Whitley Aerodrome, which comes into active being on the 25th inst., and is expected to provide a long period of steady production, whilst the development of the latest "motor gliders" is being watched with interest by local makers of light air-cooled engines.

Stamped Metal Wares Trade Wages.

The Stamped or Pressed Metal Wares Trade Board has resolved to vary the minimum rate of wages in the trade, and has asked the Minister of Labour to bring it into operation as from August 13th. The female workers of eighteen years and over are, it is proposed, to have their wages reduced by ½d. per hour, with corresponding reductions in the general minimum time rates for younger female workers, and in the piece-work basis, time rates, and overtime rates for female workers.

Unemployment in the Midlands.

The number of unemployed in the Midlands area decreased by about 800 during the week ended July 9th, the total being 154,983, as against 155,811 in the preceding week. In Birmingham there was a decrease from 41,113 to 39,732. Bilston, Coventry, Cradley Heath, Dudley, Oldbury, Smethwick, Stourbridge and Brierley Hill, Walsall and Wolverhampton all showed increases.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Conditions.

THE markets here are all very languid, and although some people talk rather confidently about a revival in the autumn, there is no cause for this expectation, unless it be the natural hope for better things which always looks to the future with confidence when the present is most depressing. Business men, however, are beginning to realise more completely that trade cannot be better until the cloud of uncertainty which hangs over Europe is lifted. A considerable amount of locomotive work has been given out lately, and the effect of this may be felt to a certain extent during the next few months; but general engineering is very much restricted. There will also be some accumulation of steel orders during the Glasgow fair holidays, and probably a temporary brightening of the feeling in Scotland when these orders are placed at the beginning of August; but it is fairly certain that the general character of the iron and metal markets cannot alter much for the better until a real peace is established and the vast population of Middle Europe gets to work again.

Metals.

The markets for the non-ferrous metals do not show much change, and there are as yet no decided indications as to the way the markets are likely to go. All that can be said is that in most cases the market prices are fairly low. Lead may be an exception and spelter perhaps is on a higher level than was common before the war; but the other metals are on a pre-war basis so far as prices are concerned, although the costs of production cannot yet be at the same level. Hence, it may be assumed that raw copper, and even tin, are fairly safe. Consumers, however, are not likely to buy very freely until trade conditions are better. The American market seems to be a little better, and American consumption of copper is good. The Americans, of course, have a very wide home market, and are not so much affected by the condition of Europe as we are; but even there some apprehension is felt as to the effect of the prolongation of the European agony upon American industries. The consumption of copper here is no doubt hampered by the continuation of the excessive prices for all manufactured forms. Ingot copper is cheap enough, but sheet copper is much too dear, and locomotive and condenser tubes are even dearer in proportion. In the metal trades—as in most other industries—the costs of manufacture, including the rates of profit, have to be brought down. There has been a very poor demand this week for scrap gun-metal and brass, and dealers here are reluctant to buy. In some cases they are refusing to offer more than £45 per ton for gun-metal scrap, which, even if of the cheapest kind, could not be made under £70 per ton, and if of good quality would cost £80. Tin has been a little stronger of late, but the general opinion in the market is that the time has not yet arrived for a "bull" movement. Apparently, when the price drops below £180, consumers come in, although, of course, this cannot be relied upon as a permanent feature. There is now a tendency towards decline in the reserves of tin, as the rate of consumption is rather above that of current production. Lead has been rather a steadier market, but there is not much change to note. The scare in America about the possibility of imports seems to have subsided. Spelter has been rather stronger than it was. The demand here, however, is still rather poor, and consumers do not seem to be afraid of higher prices.

Pig Iron.

The market here for all kinds of pig iron remains as dull as ever, and the amount of business being done is quite small and of a retail character. If one must quote a price, it is needful to take rather a wide margin, and on this principle the price of common foundry iron in Manchester may be quoted as from 105s. to 108s. 6d. per ton delivered. Merchants here will gladly take orders for delivery over the next three months at 105s., and probably at less; but if a founder wants 10 or 20 tons for delivery to-morrow he must pay 108s. 6d. The Derbyshire ironmasters still quote 100s. on trucks at the furnace for No. 3 common iron, but it is generally understood that less than this has been accepted, even by makers. Northamptonshire pig iron has been mentioned at 95s. on trucks, but this is not much better than 100s. for Derbyshire, so far as the Manchester founder is concerned. The Cleveland price is now barely 107s. 6d. on trucks, and another drop of 5s. may perhaps make Cleveland iron available for the north of Lancashire. It is, however, a good 15s. per ton away from the chance of competing against Derbyshire in the south of the county. Scotch iron is still quoted here at 125s. per ton delivered, although probably a little less would be taken.

Finished Material.

Steel prices are, if anything, a little weaker. There has been talk of steel plates at £10 2s. 6d. per ton, but there is very little inquiry for ship plates now, and practically none for boiler plates. Joists and angles are quoted at £10, but a little less would probably be accepted. The report referred to recently that the Scottish bar iron makers had reduced the price of Crown bars to £11 10s., which was current on the Manchester Exchange, is now officially denied, and the bar iron makers state positively that the price in Scotland is still £12 per ton for Crown bars. This is also the price of Lancashire Crown bar iron, and one understands that there is no intention of reducing it in present circumstances.

Scrap.

The markets for scrap are in much the same general condition of depression. Very little new business is reported, and dealers, when buying, seem to be preparing for even lower prices. Cast scrap is nominally at £4 to £4 5s. per ton, according to quality, but one hears of lower prices, and consumers seem quite indifferent. The fact is that the ironfoundries do not want the scrap at any price. For heavy wrought scrap the forges are supposed to be paying £4, but it is said that some of them are buying it at a lower figure. Steel scrap seems very depressed, and on trucks at a Lancashire station it is probably not worth more than 65s. per ton.

New Tramways Manager for Salford.

At a meeting of the Salford Tramways Committee held last week, Mr. James Scott Duncan Moffet was unanimously selected for the post of general manager of the Salford tramways, at a salary of £1000 per year, plus bonus under the Civil Service scale. Mr. Moffet was assistant to the Borough Engineer at Sunderland from 1896 to 1898, and subsequently assistant in charge of the tramways and improvement department. In 1904 he was appointed general manager and engineer of the Rochdale tramways system, a post he held until 1913. From Rochdale he went to West Ham to fill a similar position, and in 1916 he was appointed general manager of the Belfast city tramways, a post which he still holds. The Committee's decision now awaits confirmation by the Salford Borough Council.

Engineering Trades.

Notwithstanding the fairly satisfactory reports of the Board of Trade for June, the engineering industry in this district is still in a very unsatisfactory condition. From time to time during the past twelve months there have appeared to be prospects of material improvement, and hopes were raised that the tide had at last turned. But, alas! these hopes have not materialised to any appreciable extent. Most of the engineering firms in the district report that the state of their order books is far from satisfactory. Even the textile machinery makers, who have hitherto been the most happily situated, with one or two exceptions, now report that new orders are not coming in in sufficient quantity to maintain their works in a normal condition. Locomotive builders are only moderately employed, and with them, again, prospects for new business are anything but bright. Machine tool makers have only a small amount of work on hand, and the outlook for them shows no material improvement. As exemplifying the severity of foreign competition in the engineering trade at the present time, owing to the difference in exchange values, the managing director of one of our best-known engineering firms informed me of a case in which his firm had recently put in a tender for an engine, the order for which was ultimately placed with a competitive Belgium firm at just about one-half of the price of the Manchester firm's tender.

BARROW-IN-FURNESS, Thursday.

Hematite.

There is much slackness in the hematite pig iron trade, and there are further restrictions of output. Another furnace has been put out at Ulverston. Makers, finding that there are no new orders to take the place of those just finished, are putting the furnaces out rather than make for stock, for the very obvious reason that if costs of materials fall as a result of the slump, the iron put into stock will involve loss. There is not a great amount of overseas trade. There certainly is still some going on, but it is mostly the finishing up of orders placed some time ago. The charcoal furnace is still working, and there is a fair market for its products.

Iron Ore.

The iron ore trade has fallen off considerably as a result of the damping down of furnaces in the district, and many men are now out of work as a consequence. Cumberland is the busiest district, but even there there is a considerable restriction in the amount now being brought up. Foreign ore is not in great demand, and most of that which is arriving is going into stock. A cargo arrived at Barrow from Spain last week.

Steel.

The steel trade is quiet, but the Barrow works manage to keep going. The Siemens department is in operation, as well as the rail, merchant, hoop and small special sections. The foundry is also engaged. At Workington there is not much being done, and only the tire and axle departments are employed.

Shipbuilding and Engineering.

The boilermakers' dispute is holding up work at Barrow to a certain extent. The engineering departments are suffering also to a certain extent, and there are men who are idle in consequence. Engineers desiring to go to America are now experiencing difficulties.

SHEFFIELD.

(From our own Correspondent.)

Big Public Schemes.

THE Sheffield City Council and the West Riding of Yorkshire County Council are busily engaged completing plans for big developments in their respective areas for the winter months. In Sheffield it is proposed to expend a sum of £300,000 as follows:—For the provision of new public abattoirs, £120,000; bridges, £48,000; sewage disposal, £42,000; new roads, £50,000; street improvements, £15,000; construction of sewers, £10,000; and repairs to roads, £15,000. A start is to be made immediately with the construction of railway sidings and platforms at the new abattoir. The West Riding County Council is to borrow £320,514 for highway purposes. Of this, £20,910 is to provide work for the unemployed in the areas of Silsden Urban Council and Wortley Rural Council. The balance will be spent on the provision of new bridges, schools, and a small-pox isolation hospital.

Co-ordination of Electrical Power Schemes.

With a view to settling details of the East Midlands electricity scheme, the Electricity Commissioners conducted an inquiry at Nottingham this week, at which the main principles were settled. The authorities concerned are the boroughs of Nottingham, Derby, Leicester, and Burton, and also the Notts and Derbyshire Power Company. The chief point now at issue is the laying of transmission mains. The Commissioners suggest that they should be taken through those districts in which the largest potential load would be found, rather than merely in order to connect one municipality with another. That suggestion was accepted on behalf of the municipal authorities, but the parties to the inquiry were unable to agree as to the roads the cables should take. It was decided to adjourn the matter for a month in order to see if an agreed scheme could be arrived at to be presented to the Commissioners.

The Steel Trade.

The steel trade of Sheffield has begun to feel the effects of the occupation of the Ruhr, which for a time caused a big increase in the heavy steel trades of the city. There are now signs, however, that competition on the Continent is again coming to the fore, and, with the purchasing power of these countries still falling, Sheffield products stand a very small chance of being selected. The position is indicated very significantly by the fact that last week no less than 400 steel workers were added to the list of unemployed in the city, making the total number of unemployed now 27,000. Steel makers are not showing any disposition to reduce prices, the present figures meaning that business is being conducted almost at a loss. Some furnaces have again shut down. The lighter steel trades are doing rather moderate business.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipyards May Close.

A DEPLORABLE position is rapidly developing in the shipbuilding industry on the North-East Coast as a result of the boilermakers' strike. The industry was just emerging from the most overwhelming slump it has ever experienced, and was on a fair way to renewed activity, when it received a setback which threatens to reduce it to a state as bad, if not worse, than before. During the spell of revival many thousands of men were found employment, but as the outcome of the boilermakers' strike the majority again find themselves out of employment. Those still at work are mainly apprentices, but in aggravation of the situation so far as the boilermakers are concerned, that union has now called out all the apprentices who are over the age of twenty-one years. Thus what little work which comes under the head of boilermaking which was being done during the strike is being reduced to the lowest possible minimum, and unless something effective happens very shortly employers will have no alternative but to close down their yards. The irony of the situation is that there is work waiting to be done in every yard in the district, and that many contracts are being lost and secured by foreign competitors.

Cleveland Iron Trade.

In practically every branch of the iron and steel industries business is extremely quiet, and at the moment the outlook is discouraging. Few contracts are coming forward to replace those being worked off, and the opinion

is general that unless a change for the better takes place quickly a good deal of plant will have to be laid idle. Cleveland pig ironmakers are finding it difficult to retain any home markets outside their immediate vicinity, as Cleveland iron with transport charges added is dearer than that of any other area. Small quantities are going to Scotland for mixing purposes, but the home market generally is flat, work at many of the forges and foundries being interrupted by the hot weather. Moreover, as prices are still drooping, buyers continue to pursue a waiting policy, and transactions are all of a hand-to-mouth variety. Germany is still taking fair quantities of iron, but the uncertainty of the international outlook is paralysing business on the Continent, and inquiry from abroad has fallen off to a deplorable extent. Cleveland makers, however, are not disposed at the moment to cut prices further. The ironstone miners, as well as the ironworkers, have received a substantial advance in wages which will add to the cost of manufacture, and as fuel prices keep up the makers of pig iron can only cut prices by dipping deeper into their own pockets. No. 1 Cleveland foundry iron is still quoted at 115s. per ton, No. 3 G.M.B. at 107s. 6d., No. 4 foundry at 102s. 6d., and No. 4 forge at 100s.

Hematite Pig Iron.

The weakness in the hematite pig iron trade is more pronounced. Makers are keenly competing for orders to keep their furnaces going, but it is by no means certain that there may not be some curtailment of output necessary. Certainly there is no present market for all that is being produced, and makers have now cut their price of mixed numbers to 105s. both for home and export.

Ironmaking Materials.

The foreign ore trade is in a state of suspended animation. Consumers are reluctant even to take deliveries under contract, and no new business is reported, the price of best Rubio ore being nominal at 24s. per ton c.i.f. Tees. The fuel position is unchanged, though ironmasters are experiencing less difficulty in securing supplies. Good medium furnace coke is quoted at 41s. per ton delivered at the works.

Manufactured Iron and Steel.

A pessimistic feeling prevails in the manufactured iron and steel trade. Contracts approaching completion are not being replaced, and the effects of the stoppage at the shipyards are accentuated by the lack of orders in the rail trade. Generally, buyers are holding off in the hope of a further fall in prices and the output is on the down grade. This week billets have been reduced by 10s. per ton.

The Coal Trade.

The Northern coal trade position is exceedingly quiet and devoid of anything like active or buoyant optimism. There is just now a definite pause in buying, either for prompt or forward delivery. In some cases the collieries are greatly concerned about keeping the men regularly at work, though most of them are supplied with enough tonnage to permit regular working. It is difficult to account for the condition of the prompt market. For one thing, the export trade is quiet, and though there are numerous inquiries from abroad, especially from Germany, definite bookings are not being put through to any extent. This is probably due to a hope of further reductions in prices, though it is doubtful whether any further considerable fall in values may be expected. The home trade is, unfortunately, also rather quiet, and this tends to accentuate the present lull, which, however, many of the large operators regard as merely temporary, an early recovery in both the prompt and forward values being looked for. The Northumberland steam coal trade is fairly brisk so far as orders and inquiries are concerned, but is experiencing loading troubles owing to the dislocation of shipping due to the dockers' strike and other causes. The tone, however, is fairly firm, and both screened sorts and smalls are very steady, especially for the later dates of loading. The Durham market is quiet and entirely unimproved. There is hardly anything stirring in the way of contracting, and prompt business is far from brisk. Best brands of gas coal are nominally steady, with a fair inquiry to support the market, but seconds are duller and irregular both as to price and position. The coking market is said to be a shade steadier. Operators, both producers and second-hand men, are less inclined to discount prices than they were, though any alteration for the better is very slight. South Durham classes are plentiful and offered cheaply. Bunker coals are very slow of sale and inclined to be easier. Foundry coke is only moderately steady, with prices unchanged. Gas coke is easier and prices can be discounted slightly.

Ironstone Miners' Wages Advanced.

At a conference this week between the Cleveland ironstone mine owners and miners' representatives an agreement was reached by which the men's wages will be increased from July 23rd by 14 per cent., this representing about 2s. 10d. in the £. With the increase added, Cleveland miners' wages are now 102½ per cent. above the standard.

SCOTLAND.

(From our own Correspondent.)

Featureless Markets.

THE week before the annual holidays is usually a busy one even in ordinarily quiet times, but this year nothing approaching a "rush" was noticeable. Markets were dull and uninteresting, and the coming of the Fair holidays was received with relief. In most cases it was purely a matter of "hanging on" until the usual closing day, possibly in the hope of something turning up to brighten the prospect of resumption. On all hands extended holidays are reported, and in some cases the extent of the vacation, relying as it does on improving conditions, is indefinite.

Trade Conditions.

The effect of the boilermakers' dispute is widespread. Not only has work in the shipyards been hung up, but activities at the steel and ironworks in the district also have been severely curtailed. The Clyde is more or less the industrial weather-glass for the whole area, and slackness at the yards affects the entire district. The drop in local activities has not been balanced by export buying, and the dearth of new operations has been most discouraging.

Steel and Iron.

During the past week nothing has occurred to brighten the outlook, very little forward buying being reported. It becomes more and more evident that buyers are completely out of sympathy with the present level of prices, and will make no movement to anticipate requirements until more inducement is forthcoming. For some time past steel makers have booked nothing of importance in either steel plates or sections, while sheets have had only occasional export orders, mostly of the lighter gauges, to break the monotony. Bar iron works have been able to maintain fair employment by reason of large orders booked during the boom period, but of late they have only been making a fair turnover in the re-rolled steel department. The competition from continental producers has become more pronounced recently, and it remains to be seen if local manufacturers will make an effort to bring their prices into line. The pig iron works have been producing more than requirements warranted, and no improvement has followed the various reductions in prices. Consequently, there is a probability that a number of furnaces will be damped down, unless a very early increase in turnover takes place. Scrap materials share in the general stagnation. It is said that from one or two sources a better export tendency is reported, but any increase noticeable so far could make no appreciable difference in any particular industry. The outlook is very dull, and unless some unforeseen alteration takes place the latter half of the year is likely to be as unsatisfactory as the first six months.

Coal.

The Scotch coal market was naturally affected by the approach of the holidays, and business was extremely quiet towards the finish. Exporters were dissatisfied with the upward tendency in prices of round coal, and though prices receded just about as far as they had risen from the lowest level recently touched, no business of importance was concluded. Rumour promises better things on the resumption of operations, but up to the stoppage, neither merchants nor buyers were inclined to commit themselves. Washed materials, however, never lost their hold and finished on a firmer level, if anything. Shipments for the last week amounted to 319,159 tons, against 335,183 tons in the preceding week and 301,413 tons in the same week last year. The state of trade and the season of the year have been all against the home department, in which business has been extremely slow.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

THERE has been singularly little change in the general state of the steam coal trade during the past week. On the whole, the conditions are quiet, and it is a matter of surprise to find that values are upheld as steadily as has been the case, considering that the inquiry from abroad is so restricted. The demand has fallen off almost for all directions, as a result of the uncertain financial conditions prevailing on the Continent, and of the adverse way in which exchange rates have moved. There is rather more activity for Spain, more especially as the strike of dock workers at the port of Barcelona, which has been in operation for about six weeks past, has now ended, and therefore shipments are being resumed. But the fact that in spite of the paucity of inquiry, coal prices are being well maintained is a tribute to the strength of the colliery position, and shows that on paper at any rate they are well sold. Of course, it is possible that middlemen who hold considerable supplies on contract may experience some difficulty in finding an outlet for their coals, and will be prepared to make some reduction on the prices generally quoted by the collieries direct, in order to effect sales and lift the quantities due to them. There is not so much activity in arranging supplies over the second half of this year, but it is reported that the Palestine Railways have purchased about 20,000 tons of steam coals for delivery at Haiffa during August–October, and that the business has been taken by Watts, Watts and Co.

Miners and Illegal Action.

When the annual conference of the South Wales Miners' Federation was held last month resentment was expressed by some of the delegates at the legal proceedings which were being instituted against some of their members, and a resolution was passed that a special conference should be called to consider the prosecution of Federation members for carrying out "show cards" and picketing, with a recommendation that that conference should determine that if these prosecutions were proceded with, fourteen days' notice should be given throughout the coalfield. The special conference was fixed to be held on Wednesday of this week, but in the meantime the Executive Council met to consider the position, and as a consequence the general secretary sent out to all the lodges a circular pointing out that the Council had reluctantly come to the decision that to attempt any action on the lines indicated in the resolution would mean rendering a disservice to the men who had to appear at the assizes, while, furthermore, the Council had the advice of solicitor and counsel that the calling of a conference for the purpose of considering taking action of the nature stated in the resolution was in itself an illegal act. The circular proceeded to state that as the Council had no option in proceeding with the special conference, it strongly recommended the lodges to send delegates to support the Council in its efforts in the interests of the men on trial, and the members of the Federation generally, to prevent the resolution of the conference of June 19th becoming operative, and that the members should not be asked to consider whether notices to terminate contracts should be tendered.

Tin-plate Trade Outlook.

The outlook in the tin-plate trade is not at all promising, and the position as between the men and the employers is described as delicate. The Joint Industrial Council met at Swansea at the end of last week, when nineteen out of twenty-three claims advanced by the men were rejected, and the others, in accordance with the application of the men's leaders, were referred to committees for investigation. The claims that were turned down were the vital items, and included those for increased wages and for an annual week's holiday with pay. A meeting of the workmen's side to consider the position was held on Monday last, and from all accounts the decisions of the Council caused great dissatisfaction. In view of the fact that there is to be an adjourned meeting of the Council on the 30th inst., no report as to the action to be taken by the men has been made public, but it is stated that in the present mood of the men anything may happen.

Anthracite Colliery Deal.

The announcement is made that another deal in anthracite property in this district has just been completed, the Ammanford Anthracite Collieries having been purchased by Mr. J. Waddell, chairman and managing director of the Great Mountain Colliery Company, Limited. It is understood that the price is in the neighbourhood of £300,000. The property consists of two collieries, one situated at Ammanford and the other at Pontyberem, at the top of the Gwendraeth Valley, and was formerly owned by the Ammanford Colliery Company, Limited, which acquired the Pontyberem Colliery in 1910. About 1200 men are employed, and the collieries have an annual output of about a quarter of a million tons.

Miners' Wages.

Although both prices and shipments of coal from this district last month received a setback, it is confidently predicted that when the returns for May and June become known there will be an increase next September in the wages of the miners of at least 7½ per cent., thus bringing the general wage rate to over 45 per cent. above the standard rates of 1915.

Current Business.

Comparatively little fresh business has been arranged in steam coals during the past week, and the tone is generally very quiet. Collieries appear to be very well placed for the moment, and are, in fact, better off than they were last week, when the strike of the dock workers caused some dislocation, owing to tonnage being held up. The men engaged in discharging work who were on strike, resumed operations on Thursday last week, and the result is that tonnage has become ready to load. Collieries are quoting as much as 31s. to 32s. 6d. for best Admiralty large, and 30s. to 31s. for second qualities. Monmouthshire descriptions are fairly steady, and smalls are maintained on the basis of 21s. to 22s. 6d., according to quality. House coals have been reduced in price as from last week. Best qualities have been reduced from 35s. to 32s. 6d. and from 34s. to 31s. 6d., while second qualities have dropped from 34s. to 30s. These figures are, however, higher than those ruling a year ago, and are, of course, pit-head prices to merchants, but it is pointed out that the costs of production are higher than they were twelve months ago. Anthracite coals are fairly steady, and although there is rather less business about, collieries are very well sold for the next few weeks, and, of course, it has to be remembered that the approaching holidays will result in diminished production.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

BUSINESS is very quiet in the tin-plate trade, and buyers are holding off until the conditions become more settled.

Coalfield Conference.

At the special delegate conference, held on Wednesday, it was decided not to give fourteen days' notices throughout the coalfield on the question of the prosecution of Federation members. There was an overwhelming majority in favour of the Executive's recommendation.

Anthracite Deal.

The Dulais Anthracite Collieries have been purchased by Hull, Blyth and Co., the well-known coal contractors and owners of foreign coaling stations. The Dulais collieries were opened in 1905 by Mr. R. Hodgens, of Swansea, and others, and have been run as a private company.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	26/-
(1) Spanish	24/-
(1) N. African	24/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	24/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 17 6	—
No. 1 Foundry	5 12 6	—
No. 3 Foundry	5 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	5 5 0	5 5 0
No. 1	5 5 6	5 5 6
Cleveland—		
No. 1	5 15 0	5 15 0
Silicious Iron	5 15 0	5 15 0
No. 3 G.M.B.	5 7 6	5 7 6
No. 4 Foundry	5 2 6	5 2 6
No. 4 Forge	5 0 0	5 0 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge*	—	—
„ „ Foundry	5 2 6	—
(3) Northampton—		
Foundry No. 3	4 17 6	—
„ Forge	4 10 0	—
(3) Derbyshire—		
No. 3 Foundry	5 0 0	—
Forge	4 10 0	—
(3) Lincolnshire—		
Basic	5 5 0	—
Foundry	5 2 6 to 5 5 0	
Forge	5 0 0	—
(4) N.W. COAST—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	6 5 0†	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best „	13 10 0	—
Hoops	15 10 0	—
MIDLANDS—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 0 0 to 11 5 0	
Gas Tube Strip	12 10 0 to 13 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 0 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 12 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 0 0	—
Angles	9 10 0	—
Boiler Plates	14 0 0	—
Joists	9 15 0	—
Heavy Rails	10 0 0	—
Fish-plates	14 0 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0†	—
Light „	12 0 0†	—
Billets	11 0 0†	—
MANCHESTER—		
Bars (Round)	11 0 0 to 11 5 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 5 0 to 10 10 0	
„ (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	13 0 0	—
Bessemer Billets	13 10 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 10 0	—
Soft Basic	8 10 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	13 0 0	—
MIDLANDS—		
Small Rolled Bars	9 15 0 to 10 0 0	
Billets and Sheet-bars	8 0 0 to 8 10 0	
Gas Tube Strip	11 0 0 to 11 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	7 15 0 to 18 0 0	
Angles	10 0 0	—
Joists	10 0 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 5 0 to 10 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/1½
Block Tin (cash)	177 12 6
„ (three months)	178 15 0
Copper (cash)	64 12 6
„ (three months)	65 7 6
Spanish Lead (cash)	24 0 0
„ (three months)	23 10 0
Spelter (cash)	28 17 6
„ (three months)	29 0 0
MANCHESTER—	
Copper, Best Selected Ingots	69 10 0
„ Electrolytic	72 10 0
„ Strong Sheets	100 0 0
„ Loco. Tubes	0 1 1⅞
Brass Loco. Tubes	0 1 0
„ Condenser	0 1 2½
Lead, English	25 10 0
„ Foreign	24 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£21 0 0	8/-
„ 8 p.c. to 10 p.c. „	£20 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£50 0 0	18/-
„ „ 1 p.c. „	£60 0 0	21/-
„ „ 0.75 p.c. carbon	£70 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
„ „ 75 p.c.	£21 0 0 scale 6/- per unit	
„ Vanadium	16/9 per lb.	
„ Molybdenum	9/6 per lb.	
„ Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

	Export.
SCOTLAND.	
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	21/-
„ „ Ell	22/-
„ „ Splint	23/6 to 26/-
„ „ Trebles	25/-
„ „ Doubles	24/-
„ „ Singles	22/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	21/-
„ „ Splint	24/-
„ „ Trebles	25/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	20/6 to 25/-
Screened Navigation	31/-
Trebles	26/-
Doubles	24/6
Singles	23/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	22/9
Secondary Steam	21/-
Trebles	26/-
Doubles	24/6
Singles	23/-
ENGLAND.	
(8) N.W. COAST—	
Steams	31/6
Household	46/8 to 57/6
Coke	48/-
NORTHUMBERLAND—	
Best Steams	26/- to 27/-
Second Steams	24/- to 25/-
Steam Smalls	16/6 to 17/-
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	27/- to 28/-
Second	25/- to 26/-
Household	25/- to 28/-
Foundry Coke	60/- to 65/-
SHEFFIELD	Inland.
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	26/6 to 28/- —
Derbyshire Best Brights	25/- to 27/- —
„ „ House	22/6 to 23/6 —
„ „ Large Nuts	20/- to 21/6 —
„ „ Small „	15/- to 18/- —
Yorkshire Hards	21/- to 23/- —
Derbyshire „	20/- to 22/- —
Rough Slacks	11/6 to 13/6 —
Nutty „	10/- to 12/- —
Smalls	7/- to 9/- —
Blast-furnace Coke (Inland)	32/- to 33/-
„ „ (Export) f.o.b.	42/- to 43/-
CARDIFF— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	30/- to 32/6
Second „ „	29/- to 30/-
Best Dry Large	30/- to 32/-
Ordinary Dry Large	27/6 to 29/-
Best Black Vein Large	29/- to 30/-
Western Valley „	28/- to 29/-
Best Eastern Valley Large	27/- to 28/-
Ordinary „ „	26/- to 27/-
Best Steam Smalls	22/- to 23/-
Ordinary „	19/- to 21/-
Washed Nuts	30/- to 32/6
No. 3 Rhondda Large	33/ to 34/-
„ „ Smalls	26/- to 27/-
No. 2 „ Large	24/- to 25/-
„ „ Through	22/6 to 23/-
„ „ Smalls	18/- to 20/-
Coke (export)	52/6 to 60/-
Patent Fuel	33/ to 35/-
Pitwood (ex ship)	31/6 to 32/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	50/- to 55/-
Seconds	45/- to 47/6
Red Vein	32/6 to 35/-
Machine-made Cobbles	65/- to 67/6
Nuts	62/6 to 65/-
Beans	45/- to 47/6
Peas	25/- to 27/6
Breaker Duff	12/6 to 13/-
Rubbly Culm	15/- to 16/-
Steam Coals:	
Large	26/- to 27/6
Seconds	23/6 to 26/-
Smalls	18/- to 22/-
Cargo Through	22/6 to 25/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal. † Latest quotations available.

French Engineering Notes.

(From our Correspondent in Paris.)

The Coke Problem.

As soon as the French Government took possession of the Saar collieries it started to organise a scientific inquiry into the possibility of producing foundry and blast-furnace coke from the highly bituminous coal in that district. Although Germany was bound under the Treaty to supply France with a certain quantity of coke from the Ruhr, it was obvious that the consignments would be not only insufficient, but might become very precarious, as has, indeed, been the case since the Ruhr occupation; but the French hoped that methods of distillation might be devised whereby a sufficiently good metallurgical coke would be obtained from the Saar coal. For that purpose a company known as Le Coke Métallurgique was formed to carry out experimental work, and one of the processes evolved has entered upon an early stage of industrial development. It consists in thoroughly mixing a small quantity of poor coal with the Saar fuel and carbonising it at a high temperature in a narrow oven. It has been found that the proportion of poor coal can be reduced by mixing it with coke dust. The results obtained at Heinitz prove that it is possible to produce a good metallurgical coke of regular quality with from 80 to 85 per cent. of Saar coal. As, however, the coke industry cannot be allowed to depend entirely upon the supplies of poor coal, efforts are being made to produce coke by a partial distillation of Saar coal. Another process which, it is hoped, will entirely solve the coke problem so far as the Saar is concerned consists in the progressive distillation method proposed by M. Charpy. As the object in view is to prevent a breaking up of the coal when subjected to the sudden high temperature of the oven, the coal, in the form of large briquettes, is introduced into one part of the oven where the temperature is 600 deg. Cent. At this temperature the evaporation of the moisture does not cause any fracture of the coal, and when the fuel has attained the initial temperature of 600 deg. Cent. it is charged into the second part of the oven under the usual heat conditions. More than six months' practical working has shown that the system improves the quality of the coke, and it has now to be found out whether the longer time required for the operation may not be compensated for by a greater value of the by-products, for it has been ascertained that the products are much lighter, the benzol, for example, being more like petrol, while there are larger quantities of light tars. If the system is to become an industrial success the process must be adaptable to existing ovens, which it is believed can be modified for the purpose at comparatively small cost. On the whole, the Société Le Coke Métallurgique is quite satisfied with what has been accomplished, and is confident that the problem of obtaining a good metallurgical coke from Saar coal is in a fair way of being satisfactorily solved.

Reduced Tariffs.

While the new Tariff Bill is being temporarily held up, probably in deference to the objections raised by the industrial bodies all over the country which argue that it would be unwise to revise the import duties until the situation offers more stability, the Chamber of Deputies has modified certain duties in a way that is causing a good deal of disappointment to manufacturers, although generally approved of by the commercial community. The duties on only a comparatively small number of goods have been revised, but as they represent in every case a diminution of duties and coefficients, the modifications may be regarded as inaugurating a policy aiming at greater facilities for trade expansion. For a long while past the Government has been known to favour commercial development rather than a too rigid protection of home industries. As a rule the reductions are small, the coefficients on steam boilers being reduced from 2.8 to 2.6, on flywheels from 3 to 2.5, on cast iron pipes from 5 to 4.5, and on locomotive axles from 8 to 6.5. At the same time the Chamber approved the commercial arrangement which has been entered into with Belgium and Luxemburg, whereby important concessions have been accorded to those countries, and it is expected that the short-term treaty will have the effect of largely stimulating business between France and Belgium.

Aeronautics.

One of the leading features of the French naval policy is the creation of a perfectly safe seaway between Marseilles and Algiers. The idea is to make the African possessions a geographical as well as political continuation of the Mother Country. In the event of hostilities the French hope to obtain most of what they require in the way of foodstuffs and raw material from vast possessions which are believed to be capable of supplying nearly everything that may be needed. In a report just presented to Parliament upon the expenditure on aeronautics it is proposed to render the seaway perfectly safe by subsidising merchant ships specially designed with adequate underwater protection and capable of steaming at 30 knots and provided with gun emplacements so that they could be converted immediately into auxiliary cruisers. At the same time it is proposed to build a number of rigid airships of 20,000 cubic metres capacity, to be equipped with the engines surrendered by Germany. In a general way the French military authorities deprecate any expenditure of money on dirigible balloons, but it is argued that in conjunction with a fleet of fast auxiliary cruisers they would be of considerable value in keeping an open route between France and Algeria.

Paris Water Supply.

The water supply to Paris is likely to be supplemented by a further 70,000 cubic metres—say, 15½ million gallons—daily from Fontaine-sous-Jouy. The cost is estimated at 47 million francs. In view of the proposed Paris extension scheme, every available source of water supply is being investigated, and the plans already approved of will involve an enormous expenditure of money.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

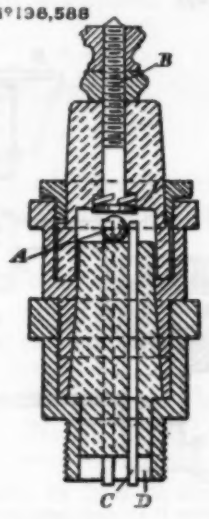
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

198,588. July 13th, 1922.—SPARKING PLUGS, M. Bailly, 6, Rue Terre Neuve, Brussels.

In this sparking plug a loose ball A is arranged between the leading-in stem B and the conductors C. The firing spark takes

N° 198,588

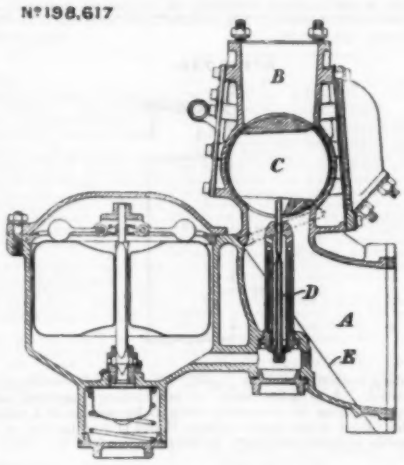


place, in the normal manner, at D, but it is, according to the inventor, increased in intensity on account of the disrupting sparks produced at the ball, which is jerked about by the vibration of the engine.—*June 7th*, 1923.

198,617. November 7th, 1922.—CARBURETTERS, D. Napier and Son, Limited, and G. S. Wilkinson, 211, Acton-vale, London, W. 3.

This carburetter is primarily intended for aircraft engines, and is so devised that the float chamber and jet can be removed without disturbing any of the connections, except the petrol pipe. The air intake A and induction pipe B are cast in one piece,

N° 198,617



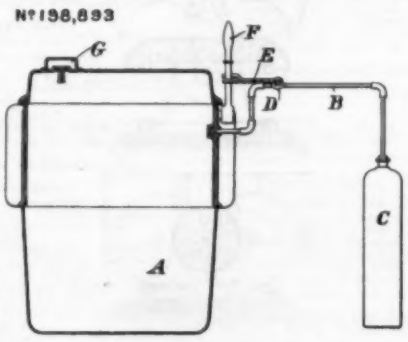
together with the throttle C. The float chamber has an extension for carrying the jet D, and is bolted up to the inlet casting by a joint E. When this joint is loosened, the float chamber and jet can be drawn away bodily.—*June 7th*, 1923.

SWITCHGEAR.

198,893. May 19th, 1922.—IMPROVEMENTS RELATING TO OIL-INSULATED SWITCHGEAR AND LIKE ENCLOSED ELECTRICAL APPARATUS, George Ellison and James Anderson, of Wallhead-lane Works, Perry Barr, Birmingham.

The object of this invention is to enable safety to be insured

N° 198,893



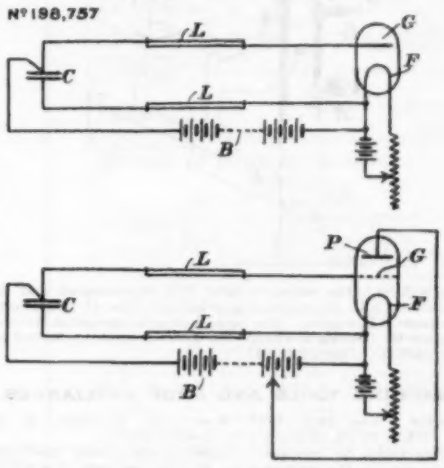
without the use of excessively massive casings. The case A of the switchgear is connected by a pipe B with a cylinder C of compressed air or other gas, and the pipe is fitted with a tap D. The tap lever E is connected to the switch operating lever F. In the open and closed positions of the lever F the tap is closed, but in moving from one position to the other, the tap is momentarily opened, admitting sufficient air or gas from the cylinder to the case to prevent the accumulation of an explosive gas mixture in the case. The case may also be fitted with a release valve G.—*June 14th*, 1923.

TELEGRAPHS AND TELEPHONES.

198,757. March 6th, 1922.—IMPROVEMENTS IN THE GENERATION OF HIGH-FREQUENCY ELECTRIC OSCILLATIONS, Marconi's Wireless Telegraph Company, Limited, of Marconi House, Strand, W.C. 2, and Ernest Walter Brudenell Gill, of Merton College, Oxford, and James Herbert Morrell, of Hill Top, Headington-hill, Oxford.

This invention relates to the generation of high-frequency electric oscillations by means of thermionic devices or valves. In the upper diagram G is the anode and F is the filament of a diode. To these electrodes are connected two parallel telescoping wires L L across the ends of which there is a condenser C. B is a battery by which the anode is made highly positive with respect to the filament. With this arrangement, the glass of the valve gets charged, and the inventors therefore surround the valve by a metal cylinder, which is made negative with respect to the filament. It is preferred, however, to employ a triode, as

N° 198,757



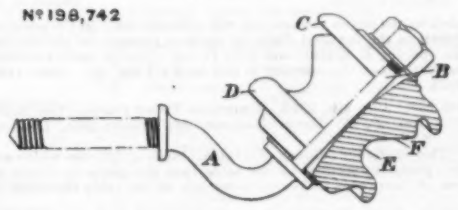
illustrated in the lower diagram. In the arrangement shown, the wires L L are connected to the grid and filament, the plate P being connected to a point in the battery B, so as to make it slightly positive with respect to the filament. Several other arrangements are described. In order to produce oscillations, the grid voltage is gradually increased until maximum oscillations are obtained for a given filament current, the plate being initially at, say, + 2 volts with respect to the filament. Then the plate voltage is varied so as to improve the oscillations, and, finally, the brightness of the filament may be varied until the best oscillations of all are attained. If the grid voltage is further increased, the oscillations fall off, but reach a second maximum when the system is oscillating on its first harmonic.—*June 6th*, 1923.

TRANSMISSION OF POWER.

198,742. March 2nd, 1922.—IMPROVED MEANS FOR SUPPORTING AND INSULATING CONDUCTORS OF ELECTRIC OVERHEAD DISTRIBUTION AND TRANSMISSION LINES OF COMPARATIVELY LOW VOLTAGE, George Victor Twiss, of 39, Victoria-street, London, S.W. 1.

The support for the insulator consists of a metallic rod A, adapted to be screwed into the supporting pole, and bent downwards in the neighbourhood of the pole and then upwards at an angle of 45 deg. to the horizontal, the upwardly projecting portion serving as the pin B, on which the insulator is threaded. The insulator itself is formed with upper and lower sheds C and D, which may be of the usual form, but the groove E in which the conductor is to be supported is formed with one side F

N° 198,742



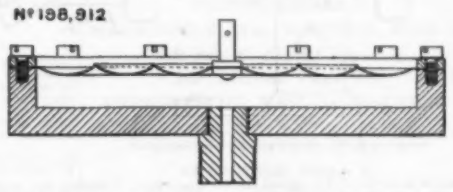
inclined at 45 deg. to the axis of the insulator, and the other side, which forms the top of the bottom shed of the insulator, at right angles to the axis of the insulator. The insulator has the portion F of its supporting surface in the form of a truncated cone with an angle of 90 deg. at its apex. An insulator constructed and arranged as described provides means for positively supporting the conductor at rest or when swung out in the wind, and also when turning through bends in the line, so that during erection the conductor can be run out on the insulator and placed in its proper position before it is bound.—*June 4th*, 1923.

MEASURING AND TESTING INSTRUMENTS.

198,912. June 15th, 1922.—PRESSURE GAUGES, W. B. Dale, 14, Alphonsus-street, Old Trafford, Manchester; R. A. Hopkinson, Britannia Works, Huddersfield, and J. Hopkinson and Co., Limited, Britannia Works.

According to this specification the diaphragms of pressure

N° 198,912



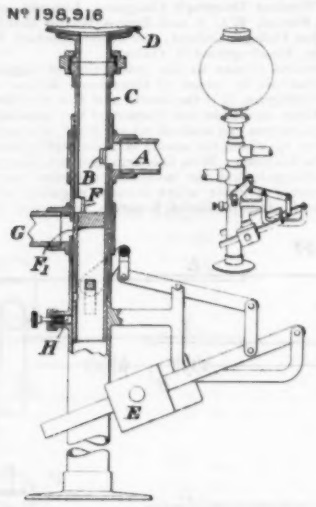
gauges for measuring small differences of pressure are made with circular corrugations of a special form, such that each corrugation comprises a comparatively wide shallow depression

rising to a sharp peak at the junction with the next corrugation; the sharp narrow corrugations give the necessary stability to prevent the buckling of the diaphragm, while the wide shallow corrugations give the necessary flexibility to the diaphragm when subjected to fluid pressure.—*June 14th*, 1923.

198,916. June 21st, 1922.—FLUID-WEIGHING MACHINES, W. G. Finch and L. R. Finch, 724, Adams-street, Grand Rapids, Michigan.

This apparatus is intended for weighing-out fixed quantities of liquid. The liquid is supplied by the pipe A and finds its way through the ports B into the pipe C, on the top of which there is a container D. When the required quantity of liquid

Nº 198,916



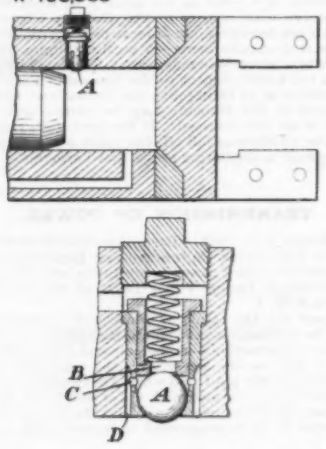
has collected, the counter-weight E is overbalanced and the container, with its supporting telescopic tube C, drops until the ports F F_1 register. The liquid is then discharged at the connection G. During discharge the moving parts are locked by the catch H.—*June 14th*, 1923.

MACHINE TOOLS AND SHOP APPLIANCES.

198,888. May 16th, 1922.—PNEUMATIC HAMMERS, *A. E. White*, 88-90, *Chancery-lane, London, W.C.* 2.

This valve, for pneumatic hammers and similar machines, is operated by the main piston. It takes the form of a ball A which protrudes into the bore of the cylinder and is thus pushed

Nº 198,888

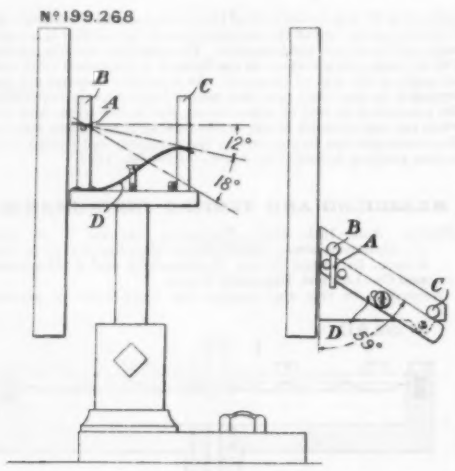


back by the piston towards the end of the stroke. In the position shown in the detailed drawing, there is passage for the air *viâ* the opening B, ports C and slots D, but when the ball is pushed back it closes the opening B and cuts off the air.—*June 14th*, 1923.

199,268. July 8th, 1922.—GRINDING TWIST DRILLS, The Right Hon. F. W. Baron Hotham, 32, Princes-gate, London, S.W. 7.

This appliance consists of a table, standing up from which are two posts, so secured to the table that the plane in which lie two of their faces makes with one side of the table the angle to

Nº 199,268



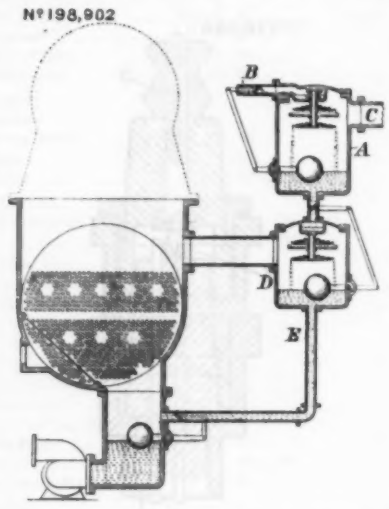
which it is desired to grind the cutting edge. Usually this angle is 59 deg. From the post which is nearest to the side in question projects a horizontal bracket or arm, on which the point of a drill can be rested while it is being ground. To the table near the side in question is secured one end of a blade spring which stands up from the table close to the posts. When it is desired to grind a drill the drill is held against the two posts B C and rests either on the pin A and the spring D; it is then advanced to the wheel until one edge is ground sharp; it is then backed off to the required extent by gradually depressing the spring D, the drill being kept pressed forward against the wheel and at the same time rotated very slightly in the direction in which it will revolve when in use. The drill is then turned over and the other lip is ground in the same way.—*June 21st*, 1923.

CONDENSERS AND FEED-WATER HEATERS.

198,902. May 29th, 1922.—DE-AERATING FEED WATER, W. S. Elliott, Frick Building, corner Fifth-avenue and Grant-street, Pittsburg, Pennsylvania.

The make-up water is admitted to the heater A at B, and is regulated by the ball valve shown. Steam for heating the water is supplied at C. After being heated the water passes

Nº 198,902



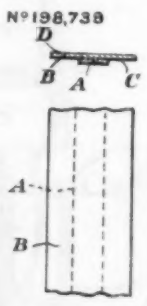
on to the evaporator D and here again the flow is controlled by a ball valve. The evaporator is connected with the main condenser, with the result that the heated water largely flashes into steam and the uncondensable gases are carried over to the condenser. The purified water passes by the pipe E to the hotwell.—*June 14th*, 1923.

MISCELLANEOUS.

198,739. March 1st, 1922.—IMPROVEMENTS IN AND RELATING TO ELECTRIC CABLES OR CONDUCTORS, Henry Charles Braun, of 154, Caledonian-road, London, N. 1.

This invention relates to insulated electric conductors, comprising one or more flat strips of conducting material, with or without a preliminary covering of insulating material, and mounted upon or between one or more layers or strips of electrical

Nº 198,738

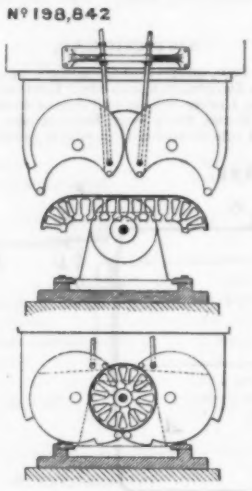


insulating material such as paper. One form of construction is illustrated. A is a flat strip of conducting material, which is mounted upon an insulating strip B by means of a suitable cement. Both of the outer surfaces C and D may be coated with a suitable adhesive cement, or only the surface C.—*June 1st*, 1923.

198,842. March 29th, 1922.—MAKING STEEL WHEELS, *A. E. White*, 88-90, *Chancery-lane, London, W.C.* 2.

In this specification a process for making spoked wheels from

Nº 198,842

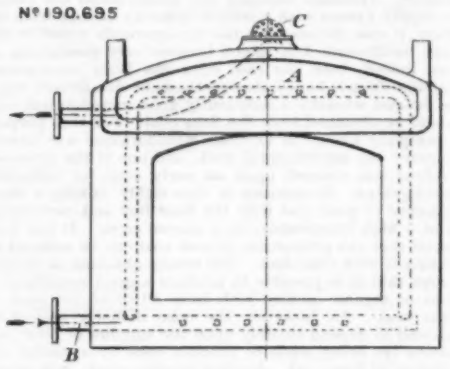


I beams is described. The web of the beam is first punched out to produce the outline of the spokes. The alternate spokes are then bent sideways. The strip is bent so that the flange of the beam forms the rim of the wheel, while the spokes become radial. The rim is then welded up, a hub inserted and the completed wheel trued up. The illustrations reproduced herewith show only the process of bending the punched strip to form the wheel. The full process of making the wheel by this method was described in our issue of July 14th, 1922.—*June 14th*, 1923.

190,695. July 14th, 1922.—IMPROVEMENTS IN AND RELATING TO ELECTRIC FURNACES, F.I.A.T. Società Anonima, Turin, Italy.

The electric furnace described in this specification has a water-cooled metallic arch A. Cooling water introduced at the point B

Nº 190,695



is conveyed into the chamber formed within the arch. A perforated dome C above the frame allows vapour or steam to escape. The object of the invention is to do away with refractory material in the usual arch.—*June 21st*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, JULY 21ST.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council House, Sutton Coldfield. West-Midland District meeting. 2.30 p.m

THURSDAY, JULY 26TH.

MANCHESTER ASSOCIATION OF ENGINEERS.—Visit to the Horwich Locomotive Works. Train leaves Victoria Station, Manchester, 2 p.m.

FRIDAY AND SATURDAY, JULY 27TH AND 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council Chamber, The Exchange, Market-place, Nottingham. Friday, 10.45; Saturday, 9.30. For programme see page 58.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

COMMANDER A. K. ATKINS, of the United States Navy, and Assistant Director of the United States Shipping Board, left for New York on the 17th inst., having been recalled to the service.

THE LAFARGE ALUMINOUS CEMENT COMPANY, Limited, has been formed, with its registered address at Regent House, Kingsway, to work in this country under an agreement with the Société Anonyme des Chaux et Ciments de Lafarge et du Teil, the French company, whereby it acquires the sole selling and manufacturing rights in respect of "Ciment Fondu" for Great Britain and the North and South of Ireland.

CATALOGUES.

SMITH BROTHERS AND CO. (Hyson), Limited, Hyson Green Works, Nottingham.—Copy of small pamphlet entitled "Some Interesting Facts about Pressure Gauges."

THE STANTON IRONWORKS COMPANY, Limited, near Nottingham.—An illustrated catalogue describing the Stanton "spun" iron pipe and its manufacture, along with tests and a standard specification for "spun" iron pipes.

PUBLIC WORKS, ROADS AND TRANSPORT EXHIBITION.—A Public Works, Roads and Transport Congress and Exhibition is to be held at the Royal Agricultural Hall, Islington, N., from November 22nd to 29th. The Congress will be directed by an organising committee, which is under the chairmanship of Sir Henry P. Maybury, K.C.M.G., C.B. Further particulars may be obtained from the managers, whose office is at 13, Victoria-street, S.W. 1.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The following new members of Council have been elected for the session 1923–24:—President, Dr. A. Russell; vice-president, Sir James Dvonshire, K.B.E.; hon. treasurer, Mr. P. D. Tuckett; ordinary members of Council: members, Mr. J. M. Donaldson, Mr. W. M. Thornton, D.Sc., Colonel T. F. Purves, Mr. G. W. Partridge, and Mr. P. Rosling; associate member, Mr. S. W. Melsom.

UNIVERSITY COLLEGE AWARDS.—The following awards have been made at University College:—Faculty of Engineering: Jews' Commemoration Scholarship (for the student of one year's standing, not being medical, who is most distinguished by general proficiency and good conduct):—J. L. Derwas; *Proz. acc.*, J. H. Hooper and Janet I. Soar. Goldsmid Scholarship (third year):—P. Hall, D. H. W. Channon, and H. Kaufman. L. F. Vernon-Harcourt Prize (Civil Engineering):—B. W. Huntsman. Diplomas in Engineering have been obtained by the following:—Civil and Municipal:—L. W. Ball, H. Clayton, C. F. O. Donaghey, C. A. Hart (with distinction), B. W. Huntsman (with distinction), H. H. Mardon (with distinction), W. R. Marrable, S. Mehew, W. T. Owen, C. S. Trapp, and A. H. Perry (War Diploma). Civil:—W. W. Zinn. Mechanical:—H. S. Boulding, L. Bradbury, K. T. Irwin, M. Roushdy, and J. F. St. G. Shaw. Electrical:—E. G. Brunker, J. E. T. Cogle, C. K. Irwin, and J. Meek.